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MIL-M-15071G (NAVY)
1 AUGUST 1969SUPERSEDING
MIL-M-15071F (SHIPS)
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MILITARY SPECIFICATION

MANUALS, TECHNICAL: EQUIPMENTS AND SYSTEMS

CONTENT REQUIREMENTS FOR

All interested commands of the Department of the Navy have concurred
in the use of this specification.

1. SCOPE

1.1 Scope. This specification sets forth Naval Ship Systems Command and Naval Electronic Systems Command content requirements for manuals necessary for installation, operation, maintenance, repair, and parts support (without the services of manufacturer's representatives) of equipment and systems (see 6.1).

1.2 Classification. Manuals shall be of the following types, as specified (see 6.2 and 6.6):

Type I —Electrical and mechanical equipment manuals.

Type II —Electronic and interior communications equipment manuals.

Type IIS—Service test electronic and interior communications equipment manuals.

Type IIX—Experimental electronic and interior communications equipment manuals.

Type III —System manuals.

1.3 Data items. The following technical manual data items are detailed by this specification (see 6.2):

- a. Book plan.
- b. Quality program.
- c. Manuscript (review) (see 3.11.3 and 3.13.4).

d. Preliminary manuals (see 6.5.10).

e. Reproducible copy.

- (1) Preliminary manual.
- (2) Final manual (basic).
- (3) Change (permanent and interim).
- (4) Revision.

f. Printed manuals.

g. Status reports.

h. Photolithographic negatives.

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

MILITARY

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| MIL-P-116 | —Preservation, Methods of. |
| MIL-D-1000 | —Drawings, Engineering and Associated Lists. |
| MIL-D-1000/2 | —Drawings, Engineering and Associated Lists. |
| MIL-M-9868/1 | —Microfilming of Engineering Documents, (35MM), for Naval Ship Systems. |
| MIL-M-24365 | —Maintenance Engineering Analysis: Establishment of, and Procedures and Formats for Associated Documentation; General Specification For. |
| MIL-M-38784 | —Manuals, Technical: General Requirements for the Preparation of. |
| MIL-P-38790 | —Printing Production of Technical Manuals; General Requirements for. |

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STANDARD**MILITARY**

MIL-STD-12—Abbreviations For Use On Drawings, Specifications Standards and in Technical Documents.

PUBLICATIONS**MILITARY**

DOD 5220.22M—Industrial Security Manual for Safeguarding Classified Information.
 NAVSHIPS 0967-000-0120—Handbook of Electronic Circuits.
 NAVSHIPS 0969-019-7000—Application Guide for Electronic Test Equipment.
 NAVEXOS P-35—Publications and Printing Regulations.

HANDBOOKS**MILITARY**

H4-1—Cataloging Handbook, Federal Supply Code for Manufacturers, United States and Canada, Name to Code.
 H4-2—Cataloging Handbook, Federal Supply Code for Manufacturers, United States and Canada, Code to Name.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

UNIFORM CLASSIFICATION COMMITTEE
 Uniform Freight Classification Rules.

(Application for copies should be addressed to the Uniform Classification Committee, 202 Union Station, 516 West Jackson Boulevard, Chicago, Illinois 60606).

UNITED STATES OF AMERICA STANDARDS INSTITUTE (USAS)

X3.5 —Flowchart Symbols for Information Processing.
 Y14.15—Electrical and Electronics Diagrams.
 Y32.2 —Electrical and Electronics Diagrams, Graphic Symbols For.
 Y32.14—Logic Diagrams; Graphic Symbols for.
 Y32.16—Electrical and Electronics Reference Designations.

(Application for copies should be addressed to the United States of America Standards Institute, 10 East 40th Street, New York, N.Y. 10016.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 Precedence. In the preparation of technical manuals, when conflict exists between the requirements of this specification and its referenced documents, this specification shall take precedence. When conflict exists between the requirements of the contract and this specification or its referenced documents, the contract shall take precedence.

3.2 Security classification. The security classification of manuals shall be assigned by the command or agency concerned. Marking, handling, and production of all classified material shall be in accordance with the DOD 5220.22M Industrial Security Manual for Safeguarding Classified Information. DD Form 254 (Contract Security Classification Specification), which constitutes a part of the contract for all classified material, identifies and indicates the sensitive equipment features requiring security classification.

3.2.1 Data subject to higher classification than the equipment. When data included in the technical manual has a higher classification than the equipment, a table shall be included in the list of effective pages identifying the data by its downgrading group, paragraph and figure numbers.

3.2.2 Data not subject to automatic downgrading. When classified data is not subject to automatic downgrading with the declassification of the equipment, a table shall be included in the list of effective pages identifying the data by its downgrading group, paragraph and figure numbers.

3.3 Level of writing. The level of writing and development of text for types I, II, IIS, and III manuals shall be in accordance with MIL-M-38784 and the following:

a. As a general guide, the level of writing should be for a high school graduate having specialized training as a technician in Navy training courses.

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b. Summary portions in chapter 1 shall be written to the level of command and supervisory personnel.

c. Operating instructions shall be written to the level of an operator having previous experience in the operation of similar or related equipment.

d. The level of writing for other portions of the manual shall be to that of a technician (Navy Technician Third Class) having previous maintenance experience with similar or related equipment.

e. Type IIX manuals shall be written to the level of a graduate engineer familiar with the type of equipment involved.

3.3.1 Accessibility and referencing of data. Cross referencing techniques in text and illustrations shall provide rapid access to all maintenance data (equipment and equipment circuits) in such manner that the technician may proceed through the maintenance action without interruption or dead-end. Referencing shall be as specified in 3.7.4.

3.4 Issues and arrangement.

3.4.1 Issues. The issues of a technical manual shall be as specified in the contract or order and as specified in 3.4.1.1 through 3.4.1.5.2.

3.4.1.1 Basic manual. The basic issue of a technical manual shall be the original edition prepared in full conformance to this specification and in accordance with the requirements of the applicable contract.

3.4.1.2 Preliminary manual. A preliminary manual shall be prepared for type I, type II, or type III manuals, as specified (see 6.5.10.1 and 6.5.10.2).

3.4.1.3 Commercial manual. A commercial manual shall be a manufacturer's existing manual containing technical information covering assembly, installation, operation, servicing, overhaul, and parts identification, normally furnished by a manufacturer to purchasers of his equipment. As required, this manual shall be supplemented (see 3.4.3.3). (The commercial manual is sometimes referred to as an "off-the-shelf" manual.)

3.4.1.4 Supplement manual. A supplement manual is a document that complements the data in a manual.

3.4.1.5 Revisions. Revisions shall be of two types, as specified in the contract or order, and shall be prepared in accordance with MIL-M-38784 and this specification (see 3.10.4 and 6.5.13).

3.4.1.5.1 Updated revision. An updated revision shall incorporate configuration modifications and all previous data issued as changes to the existing manual, and shall be prepared in accordance with the content and format arrangement of the basic manual.

3.4.1.5.2 Complete revision. A complete revision shall be a completely rewritten manual and shall comply with all of the content and format requirements of this specification.

3.4.2 Arrangement. Manuals shall contain the following data, as applicable, to provide instructions for installation, operation, and maintenance and shall be arranged as follows:

- Front matter
- Technical content
- Appendixes
- Index
- User activity comment sheets

3.4.2.1 Front matter. The front matter shall consist of the following, as applicable:

- Cover
- Title page
- List of effective pages
- Change record
- Approval and procurement record page
- Content assurance pages
- Table of contents
- List of illustrations
- List of tables

3.4.2.1.1 Cover and title page. The cover and title page shall be prepared in accordance with MIL-M-38784 and shall include, if applicable, a supersedure notice (see 3.10.2). Manuals procured by the Naval Ship Systems Command or the Naval Electronic Systems Command, or any of its subordinate or field activities, shall show the respective systems command in the authority notice. Title pages for permanent changes shall be in accordance with 3.10.3.

3.4.2.1.2 List of effective pages. The list of effective pages shall be prepared in accordance with MIL-M-38784 (see 3.10.2 and 3.10.3).

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3.4.2.1.3 Change record. A permanent change record prepared in accordance with MIL-M-38784 shall follow the list of effective pages.

3.4.2.1.4 Approval and procurement record page (types I and III). As required, an approval and procurement record (APR) page shall be included and conform in content to figure 1.

3.4.2.1.5 Content assurance pages. Content assurance pages shall follow the title page or APR page and shall conform to figure 2. In multivolume manuals, these pages shall be included in each volume covering the content of that volume.

3.4.2.1.6 Table of contents, list of illustrations, and list of tables. These items shall be prepared in accordance with MIL-M-38784. In multivolume manuals, volume I shall contain a complete table of contents and list of illustrations covering all volumes. Other volumes shall contain their own listings.

3.4.3 Technical content. The technical content shall be as specified in 3.4.3.1 through 3.4.3.4.

3.4.3.1 Basic manual. The technical content for the basic manual shall include as applicable the following:

Type I manual—(see 3.5.2 through 3.5.10).

Types II, IIS, IIX—(see 3.5.2 through 3.5.11.2).

(Note: For paragraphs not applicable to type IIS and type IIX manuals (see 3.5.11.1 and 3.5.11.2).

Type III manual—(see 3.6 through 3.6.10.11.2).

3.4.3.2 Preliminary manual. A preliminary manual is prepared for type I, type II and type III manuals (see 6.5.10.1 and 6.5.10.2).

3.4.3.3 Commercial manual. A commercial manual shall include the basic data as specified in 3.5.2 through 3.5.10 and may be arranged in any logical format. A supplement shall be provided with each commercial manual to provide any required data not included in the commercial manual (see 3.4.3.2).

3.4.3.4 Supplement manual. A supplement manual shall be prepared in accordance with MIL-M-38784 as applicable, and shall contain all data specified in 3.5.2 through 3.5.2.10 that is not included in the commercial or technical manual it supplements. Format requirements shall parallel and augment the basic manual. Production requirements shall conform to the applicable requirements of 3.8.

3.4.4 Appendixes. Appendixes shall conform to MIL-M-38784 and the following (see 6.2):

a. For classified equipment, a copy of DD Form 254 applicable to the equipment shall be included as an appendix to each volume of the manual.

b. Manual changes shall not be issued in the form of an appendix.

3.4.5 Index. An alphabetical index, prepared in accordance with MIL-M-38784, shall be prepared for all manuals containing over one hundred pages.

3.4.6 User activity comment sheets. The manual shall include three user activity comment sheets (figures 3 and 4) in each separately bound volume. These sheets shall be located immediately following the last page in the manual.

3.5 Technical contents for equipment manuals (types I, II, IIS and IIX).

3.5.1 Applicability. Certain paragraphs between 3.5.2 through 3.5.10 are only applicable to type I or type II manuals. These paragraphs are prefixed as applicable to type I or type II manuals and are set in distinctive type faces. Paragraphs not designated apply to both type I and type II manuals. Type IIS and IIX manual requirements are specified in 3.5.11.

3.5.2 Chapters. The contents shall be arranged in chapters in accordance with the following:

- Chapter 1—General Information.
- Chapter 2—Operation.
- Chapter 3—Functional Description.
- Chapter 4—Scheduled Maintenance.
- Chapter 5—Troubleshooting.
- Chapter 6—Corrective Maintenance.
- Chapter 7—Parts List.
- Chapter 8—Installation.

3.5.3 Chapter 1, General information. The content of this chapter shall be such that command-level, supervisory personnel, and

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other users having a general interest in the equipment can easily and rapidly determine the purpose, physical and functional characteristics, and the operational capabilities of the equipment.

3.5.3.1 Introduction. The introduction shall provide an explanation of the purpose, scope, supersedure data, and applicability of the technical manual including the models, serial numbers, and configurations covered. For types II, IIS, and IIX manuals, the interface relationship of the technical manual to other publications and the relationship of the equipment to systems or other equipment shall also be included. Warranty/guarantee information shall be included, when applicable.

3.5.3.2 Equipment description. The equipment description shall describe the intended use (why, where, when, how, and with what), capabilities, and limitations of the equipment. Text covering physical description or structural arrangement shall be brief, with special attention given to avoiding unnecessary or repetitious details that are easily illustrated. All units of the equipment shall be clearly illustrated and identified. If the technical manual covers more than one equipment configuration, a table defining the differences shall be included.

3.5.3.3 Relationship of units. A pictorial illustration representing all units comprising the equipment shall be included and shall be designated figure 1-1 (see figure 5). The illustration shall show the major units of the equipment, relative size of each unit, basic interconnections between units, and their relationship with other equipment. The illustration shall be a lefthand full page or foldout (never backed up) and shall be assigned the folio (blank/1-0).

3.5.3.4 Reference data. Reference data, equivalent to the following, shall be included in tabular form:

a. Descriptive (nameplate data) which identifies manufacturer, type, model, and component identification number (CID), as applicable.

b. Functional characteristics, such as: power requirements, horsepower, pressure, capacity, modes of operation, power output, frequency, pulse characteristics, sensitivity,

selectivity, including tolerances, where applicable.

c. Capabilities and limitations, such as: pounds of thrust, knots, turning radius, minimum and maximum ranges, degree of coverage, resolution, accuracy.

d. Rated outputs, such as: wattages, voltages, horsepower, gallons per minute.

e. Environmental characteristics, such as: ambient temperatures, heat dissipation per unit, humidity limits.

3.5.3.5 Equipment, accessories and documents supplied. A tabular listing of all equipment and documents supplied shall be included. List the equipment and its units, and accessories (special tools, test equipment, miscellaneous parts, and Government furnished items) which form a part of or are supplied with the equipment. The table shall include the following:

a. *Column 1, Quantity.* This column shall contain the quantity of each unit and accessories supplied with the equipment.

b. *Column 2, Item name or nomenclature.* This column shall contain the official name (e.g., pump, winch) or nomenclature (name and designation) of each component, unit, or accessory.

c. *Column 3, CID number or unit number.* This column shall contain the CID (if available) or unit number of each equipment unit or accessory.

d. *Column 4, Overall dimensions.* This column shall contain the crated and uncrated height, width, and depth in inches (or inches and centimeters) of each unit or accessory.

e. *Column 5, Weight and volume.* This column shall contain the crated and uncrated weight and volume in cubic feet of each unit and accessory.

3.5.3.6 Equipment and publications required but not supplied (types II, IIS, and IIX). A tabular listing of all test equipment and publications required but not supplied shall be included. Unless otherwise specified, selection of test equipment shall be made from NAVSHIPS 0969-019-7000; Navy approval must be obtained in writing for nonstandard test equipment. The listing shall contain:

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a. *Column 1, Category.* This column shall contain the name of each piece of equipment required.

b. *Column 2, Recommended equipment.* This column shall contain the Government nomenclature of the recommended equipment.

c. *Column 3, Alternate.* This column shall contain the Government nomenclature of an alternate test equipment.

d. *Column 4, Equipment test parameters.* This column shall contain the range of equipment parameters tested for each recommended test equipment (not the range of the test equipment).

e. *Column 5, Application.* This column shall indicate the intended use of the equipment (e.g., scheduled maintenance, troubleshooting, corrective maintenance, or installation).

3.5.3.7 Field changes and factory changes (types II, IIS, and IIX). A table of field and factory changes shall be included as follows:

a. *Column 1, Change number.* This column shall list the change number for each field and factory change considered and included in the preparation of the manual.

b. *Column 2, Nomenclature.* This column shall list the equipment nomenclature and serial numbers of equipments affected by the change.

c. *Column 3, Description.* This column shall contain a brief statement identifying the change and its purpose.

3.5.4 Chapter 2, Operation. Operating instructions shall include all the procedures necessary to enable operating personnel to efficiently and effectively use the equipment in accomplishing its designated task(s). Chapter 2 shall contain the data specified in 3.5.4.1 through 3.5.4.3.1.

3.5.4.1 Introduction. The introduction shall describe the operator's relationship to the equipment and shall identify those units having controls and indicators which he is expected to use in the performance of his duties. The introduction shall be supported by illustrations which identify and locate all operator controls and indicators.

3.5.4.2 Controls and indicators. A description of all operator controls, indicators, protective devices and jacks shall include the following:

a. Names of panel designations as marked on the equipment.

b. Positions and operating functions for each control, and the normal operating condition of each indicator in each of the operating functions.

c. The text shall be supported by detailed illustrations (see figure 6).

3.5.4.3 Operating procedures. Operating procedures shall include the following:

a. *Operator turn-on.* This procedure shall include all steps necessary to bring the equipment from OFF through STANDBY condition to full operation.

b. *Modes of operation.* Procedures shall be provided for each mode of operation, e.g., manual, automatic, local, remote, etc. The use and relative advantage of each mode shall be described.

c. *Operation under interfering conditions.* Describe the equipment anti-jamming and interference reduction features, the advantages of each feature, and the operating procedures to be followed in all possible situations.

d. *Operator turn-off.* This procedure shall include all steps necessary to bring the equipment from full operation through STANDBY to OFF condition.

e. *Battle-short or emergency operation.* This procedure shall cover operating the equipment during emergency conditions (control air failure, lube oil failure, loss of cooling water, etc.). Emergency operator maintenance instructions shall be included. Provide a warning to return the equipment to proper operation when the emergency is over.

f. *Emergency turn-off.* This procedure shall cover turning the equipment off during an emergency (fire, water, smoke, hazard to personnel, loss of coolant, normal power, etc.).

3.5.4.3.1 Method of presentation. Operating procedures shall be presented in tabular form. Operating procedures and adjustments shall be presented in concise, simply-worded, step-by-step procedures and shall include the following:

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a. A short explanation of the operation to be performed.

b. Initial safety requirements (actions, inspections, and reference to emergency turn-off procedures).

c. Connection of any accessory equipment not permanently connected.

d. Instructions for obtaining or confirming, the presence of all critical inputs such as power, coolant, air, signal, air conditioning, etc.

e. Procedures for setting controls and making adjustments which must be accomplished by the operator prior to equipment turn-on.

f. Procedures for determining operational readiness and the acceptable indications expected from built-in indicators such as meters, lamps, gages, cathode ray tubes, and recorder readouts.

g. Milestones in the operational status of the equipment shall be identified and included by brief statements such as "the generator is now in STANDBY."

h. Visual or aural observations which occur as a result of an operator action, such as boom lowering, sweep rotation, blower motor running, etc.

i. Procedures that can be hazardous to personnel or equipment shall be emphasized by WARNINGS or CAUTIONS placed prior to the specific step involving the possible hazard.

j. Illustrative material supporting the procedures shall identify and locate all operating controls and indicating devices as well as normal in-use positions or indications.

k. Operator's checks and adjustments in proper sequence.

l. Operator's maintenance actions and schedules.

3.5.5 Chapter 3, Functional description.

3.5.5.1 *Type I.* Chapter 3 shall include a description of how the equipment operates. The description shall be simplified technical language and shall be supported by simple line illustrations, preferably on the same page. A building block technique shall be used to functionally describe the operation of the equipment as follows:

a. Major parts of the equipment shall be described and illustrated as shown on figure 7.

b. Interaction of major parts shall be described and illustrated as shown on figure 8.

c. Detailed mechanical and electrical functional description shall be described and illustrated as shown on figure 9.

d. A description of how it works or operates shall be illustrated as shown on figure 10.

e. Simplified diagrams in accordance with 3.5.5.2.3 through 3.5.5.2.5.

3.5.5.2 *Types II, IIS, and IIX.* Chapter 3 shall include a detailed analysis of the principles of operation of the overall equipment and its major functions. The development of the equipment outputs in each mode of operation shall be described. Functional diagrams (e.g., transmit, receiving, control, cooling, etc.) shall be used as the primary means of communication; text shall be used only to support the diagrams as necessary for clarity. The descriptions shall be presented in successive levels of increasing detail as follows:

a. *Level 1 (overall level).* Describe the overall block diagram (see 3.5.5.2.1). All major functions of the equipment shall be described at this level. Supporting functions such as power, cooling, and control shall also be described at this level.

b. *Level 2 (major functional level).* Describe the development of each equipment output at the level of detail shown on its functional block diagram (see 3.5.5.2.2).

c. *Level 3 (circuit level) (type II).* Briefly describe conventional electronic circuits found in NAVSHIPS 0967-000-1020; support the description by reference to the maintenance schematic diagrams in chapter 5. Describe in detail circuits not covered in NAVSHIPS 0967-000-1020; support these circuits by simplified schematic diagrams (see 3.5.5.2.3). Describe alternating current (a.c.) and direct current (d.c.) power distribution in detail; support the descriptions by reference to the power distribution diagrams in chapter 5. Describe mechanical devices, cooling systems, etc.; support the descriptions by reference to diagrams specified in 3.5.5.2.4 and 3.5.5.2.5.

3.5.5.2.1 *Overall block diagram.* The overall block diagram shall show all the major functions of the equipment and shall correlate the physical and func-

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tional groupings of the equipment in a logical manner (see figure 11). The following shall apply:

- a. For multiunit equipments, the hardware blocks shall correspond to units and shall show the functional generation of outputs, cooling, air pressurization, power distribution, etc. For multifunction single unit equipments, blocks for assemblies shall be used.
- b. The blocks shall be rectangular, with connecting lines and arrowheads showing the direction of the flow.
- c. (Type II.) Each block shall be identified by the name, nomenclature, and unit number.
- d. Each equipment input and output shall be identified by title. Waveforms shall be included as applicable.
- e. Modes of operation shall be identified by title or symbols, as applicable.

3.5.5.2.2 Functional block diagrams. Each of the major functions of the equipment included on the overall block diagram (see 3.5.5.2.1) shall be described on a separate functional block diagram. Functional block diagrams shall depict the development of each equipment function from input to output in detail (see figure 12). The following shall apply:

- a. All units, assemblies, and subassemblies shall be shown and identified by name or nomenclature (name and type number), unit number, and reference designation as separate blocks in the signal path.
- b. Hardware blocks shall be used more than once to maintain logical signal flow.
- c. Signal flow shall be from left to right and from top to bottom.
- d. Each equipment input and output shall be identified by titles. Waveforms shall be included, as applicable.
- e. Modes of operation shall be identified by title or symbols, as applicable.

3.5.5.2.3 Simplified schematic diagrams. These diagrams shall show, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. These diagrams shall be arranged functionally to show the operation of the circuits

in the same manner as illustrated in NAVSHIPS 0967-000-0120.

3.5.5.2.3.1 Integrated circuits and micro-miniature capsules. Simplified schematic diagrams shall be included for circuits within different types of integrated circuits and micro-miniature capsules in the functional manner shown in NAVSHIPS 0967-000-0120.

3.5.5.2.4 Simplified piping diagrams. These diagrams (hydraulic, pneumatic, or fluid) shall show the interconnection of components by piping, tubing, or hose and sequential flow in the system. Pumps, heat exchangers, valves, gages, etc., shall be clearly identified.

3.5.5.2.5 Mechanical schematic diagrams. These diagrams shall show sufficient detail to explain the operational sequence and arrangement of a mechanical device including the electrical control circuits (see figure 13). Nomenclature, symbols, part identifying numbers, and necessary descriptive data shall be shown as required. Gears, shafts, clutches, levers, mechanically-driven switches, motors, synchros, etc., shall be shown in functional arrangement. Gear ratios or number of teeth and direction of rotations, etc., shall be given.

3.5.5.2.6 Digital equipment. The functional description of digital equipment shall be similar to that for conventional equipment. However, the functional and hardware makeup of digital equipment requires a variation in the method of presentation and descriptive requirements. Special considerations relative to the functional description of digital equipment are specified herein.

3.5.5.2.6.1 Method of presentation. An overall description of the functional relationship of the logic sections, units, and assemblies comprising the equipment shall be provided. The following shall be included:

- a. An introduction to and description of the signal characteristics:
 - (1) Signal levels or bi-stable states utilized by the equipment; i.e., true (1) and false (0), and their relative voltage levels.
 - (2) Interpretation of the word-code bit structure; i.e., address, instruction, or data bit codes.
 - (3) Signals, identified by their operational accomplishment.

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b. Overall and functional block diagrams and descriptions as required by 3.5.5.2.2.

c. Logic principles shall be described beginning with an introduction to the basic digital logic symbology used in the manual. Each logic function shall be described and supported by Boolean equations, truth tables, simplified logic diagrams, and timing diagrams.

d. Functional description of power distribution, power supplies and regulators shall conform to 3.5.5.2(c).

3.5.6 Chapter 4, Scheduled maintenance. This chapter shall contain preventive maintenance procedures and performance test instructions to be accomplished on a scheduled basis. (Normally, shipboard planned maintenance is conducted aboard ship in accordance with a schedule and procedure set forth on planned maintenance cards. For guidance in establishing procedures, planned maintenance documents applicable to a particular generic family of equipment may be obtained from the Manager, Maintenance Field Office, 3321 East Princess Anne Road, Norfolk, Va. 23504 or Manager, Maintenance Field Office, San Diego, Calif. 92136.) When the contract or purchase order requires the preparation of planned maintenance cards, in addition to the preparation of the technical manual, it is necessary to repeat the preventive maintenance procedures in the manual.

3.5.6.1 Introduction. The introduction shall be an explanation of the purpose, scope, and arrangement of the scheduled maintenance data. When a preventive maintenance procedure is critical to the operation of the equipment and the schedule for servicing is absolute (not just recommended), this information shall be conspicuously written as a caution. The following statement shall be included for type II manuals: "The scheduled maintenance instructions in this manual are cancelled when the Planned Maintenance System (PMS) is implemented for this equipment aboard your ship or station."

3.5.6.2 Scheduled maintenance action index (type II). This index shall include all scheduled performance tests and preventive maintenance procedures. The index shall be tabulated as follows:

a. *Column 1, Periodicity.* This column shall contain an alpha-numeric list of all maintenance ac-

tions contained in the chapter. The following periodicity symbols, as appropriate, shall be used in the order of increasing periodicity as listed below:

Interval	Symbols
Daily -----	D
Weekly -----	W
Monthly -----	M
Quarterly (3 months) -----	Q
Semiannually (6 months) -----	S
Annually (12 months) -----	A
Overhaul cycle -----	C
As specified (explain circumstances) -----	R ¹

¹ An R periodicity will be preceded by a recommended calendar periodicity (e.g., DR, WR, MR, etc.).

b. *Column 2, Maintenance action.* This column shall list the maintenance action which corresponds to the periodicity number in column 1.

c. *Column 3, Reference.* This column shall state the paragraph number that contains the procedure listed in column 2.

3.5.6.3 Preventive maintenance procedures (types II, IIS, and IIX). These procedures shall include the information required to inspect, clean, and lubricate the equipment, and shall contain:

a. Safety precautions.

b. Tools, parts, materials, and test equipment required.

c. Cleaning solvents. Solvents shall be identified by Government specification numbers and Federal stock numbers.

d. Instructions for properly maintaining all safety devices and interlocks, with warnings, and cautions.

e. Instructions for lubrication at shipboard operating temperatures; also types and quantities of lubricants to be applied. Lubricants shall be identified by Government specification numbers and Federal stock numbers. Specific lubricants for arctic or tropic environments shall be included. When a proprietary lubricant is approved, a Government specification lubricant shall be listed as an emergency substitute.

f. The minimum rating of the technician who can be expected to perform the task.

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g. Procedures of obtaining access to subassemblies or subcomponents.

h. Instructions for in-place balancing and noise reduction.

i. Inspection procedures for parts which deteriorate due to cycles of use, age, or climatic conditions.

j. Illustrations to identify lubrication points and other pertinent data.

k. Other information pertinent to these procedures.

3.5.6.4 Scheduled performance tests (types II, IIS, and IIX). These tests shall contain step-by-step procedures necessary to verify that the equipment is operating within standards in all modes of operation and shall contain the following:

a. Safety precautions.

b. A list of tools and test equipment identified by type, manufacture, and model number.

c. The title of the test to be performed.

d. The minimum rating of the technician expected to perform the task.

e. Preliminary setup data required to perform the test.

f. Detailed procedures for accomplishing the test. Procedures requiring lengthy and identical setup data may be presented in detail in one procedure and referenced in succeeding procedures.

g. Values or conditions, with tolerances, indicative of normal operation.

h. *Type II.* References to troubleshooting or corrective actions to be used if the test values are not within tolerances.

i. Illustrations to support the test.

3.5.6.5 Plan for maintenance and overhaul procedures (type I). Chapter 4 shall be based on a maintenance engineering analysis. It shall provide on a comprehensive and systematic basis, the most effective and efficient procedures for performing maintenance and overhaul.

3.5.6.5.1 Maintenance engineering analysis. In the maintenance engineering analysis, representative considerations to be weighed and incorporated shall include the following:

a. Reliability, maintainability, simplicity, and ruggedness. Tasks shall be straightforward and allow some margin for error. Comparative overall benefit of nonrepairable versus repairable parts shall be considered.

b. Possibility of maintenance induced faults.

c. Transient and static operating conditions (maximum and minimum seawater, air and other ambient), shock, vibration, wear, corrosion, erosion, fatigue, operating temperature, moisture, roll, pitch, air-blast, and other environmental forces, as applicable, which will affect the continued satisfactory performance of each part.

d. Accessibility, ease of removal and replacement of parts requiring frequent removal.

e. Safety.

f. Methods of calibration and adjustment.

g. Rotatables (replacement of assembly for subsequent overhaul and reissue versus spot overhaul or repair).

3.5.6.5.2 Detailed requirements. This plan shall be developed and time-phased to allow major items of work to be conducted during the ship overhaul period. (Overhaul need not return the item to new condition, but to the condition necessary to perform acceptably on a lowest overall life cycle cost basis until the next overhaul.) The procedures shall provide independence from shore-based activities except for major repairs and major overhauls.

3.5.6.5.3 Schedule. The plan for maintenance shall set forth a time schedule of all maintenance actions (inspections, tests, adjustments, reconditioning, overhaul, and acceptance criteria) which should be taken, all parts which should be replaced, and all other parts which should be available to allow replacement if inspection so indicates over the life cycle of the ship. The procedures shall provide detailed maintenance and overhaul procedures at all maintenance levels (shipboard, tender, shore) to provide for the reconditioning or replacement of each part subject to continuing degradation, before the degradation results in major failure. It shall specify in detail the inspection measurements, tolerances, work, tests, and quality assurance operations required to provide satisfactory maintenance and overhaul.

3.5.6.5.4 Reconditioning procedures. The plan shall include reconditioning procedures on replaced parts to allow for reuse.

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3.5.6.5.5 Parts availability. This plan shall establish the range, depth, and schedule for availability of each shipboard, tender, and shore-based maintenance part throughout the service life of the ship. The procedures shall also specify any required inspection, storing, and testing requirements on stocked parts (and periodic replacements where shelf life is a factor).

3.5.6.5.6 Overhaul, maintenance, and repair standards. This plan shall also provide detailed overhaul maintenance and repair standards including:

a. Pre-overhaul performance, hydrostatic, or other evaluation tests.

b. Pre-overhaul and maintenance inspections—GO/NO-GO acceptance-rejection criteria for wear, dimensions, clearances, surface finishes, electrical resistances, alignments, backlash, play, leakage, vibrations, noise, aging, corrosion, erosion (or other standards of acceptance, as appropriate) for each applicable part. Criteria shall be predicated on the need for satisfactory performance with no more than routine maintenance until the next similar inspection. Calibration requirements for special tools and instruments.

c. List of items which should be replaced and those which should be available for replacement if inspection so indicates. (Provide guidance on comparative suitability of worn-in parts versus new parts, wherever appropriate.)

d. Detailed disassembly procedures.

e. Procedures for reconditioning reusable parts and subassembly before reassembly.

f. Critical inspection and review procedures for new parts (including comparison with parts being replaced to establish equivalence before installation).

g. Critical operations and checks during reassembly.

h. Quality assurance and post-overhaul (or maintenance) tests and inspections to assure suitability (including method of testing and run-in operations where required).

3.5.6.5.7 Format requirements. Chapter 4 shall be divided into separate sections as follows:

a. Section 1. A life cycle schedule of the required overhaul and maintenance actions arranged as follows:

FREQUENCY	TITLE OF WORK ITEM	APPLICABLE PARAGRAPH OF SECTION 3
-----------	--------------------	-----------------------------------

b. Section 2. Overhaul, maintenance and repair standards, providing GO/NO-GO acceptance/rejection criteria for all parts subject to continuing degradation in service. Reference the drawings in section 6, as appropriate.

c. Section 3. Details of all shipboard maintenance and overhaul actions (inspections, tests, disassembly, adjustments, reconditioning, work operations, replacements, assembly, calibration of test equipment, and quality assurance actions). Reference the drawings in section 6, as applicable.

d. Section 4. Details of tender and shore-based maintenance and overhaul actions supplementing requirements in section 3 to encompass all maintenance and overhaul requirements for the life of the part. Reference the drawings in section 6, as appropriate.

e. Section 5. Performance test and quality control actions during and after reassembly to assure satisfactory performance.

f. Section 6. Detail, subassembly, and assembly drawings (and photographs, where appropriate) necessary for a satisfactory understanding of the maintenance and overhaul unless otherwise included in chapter 6.

3.5.7 Chapter 5, Troubleshooting.

3.5.7.1 Type 1. This chapter shall contain all instructions and information necessary to locate troubles and conduct tests on each component, assembly, or subassembly of the equipment as follows:

a. Troubleshooting guides in accordance with 3.5.7.2.12 for logical isolation of faults. This information shall direct the technician to observe meters, fuses, circuit breakers, valves, and other available indicators which would indicate the presence of trouble.

b. Complete instructions on signal tracing for electric circuits including the use of special test instruments and unusual servicing techniques.

c. Troubleshooting diagrams including schematics giving details of mechanical and electrical assemblies and relationships as follows:

(1) Mechanical schematic diagrams in accordance with 3.5.5.2.5.

(2) Schematic diagrams in accordance with 3.5.7.2.4.

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(3) Piping diagrams in accordance with 3.5.7.2.3.2.

(4) Control diagrams in accordance with 3.5.7.2.3.3.

(5) Power distribution diagrams in accordance with 3.5.7.2.3.4.

3.5.7.2 *Types II, IIS, and IIX.* This chapter shall contain all the information required to enable the technician to locate malfunctions in the equipment.

3.5.7.2.1 *Introduction.* The introduction shall explain the approach and logic of the troubleshooting principles presented in the manual. Describe the troubleshooting data and show how they relate to one another.

3.5.7.2.1.1 *Troubleshooting index (type II).* The troubleshooting index shall be presented in tabular form. The index shall list all equipment, major and supporting functions in alphabetical order, provide references to the technician to the appropriate procedures and diagrams that are to be used to troubleshoot a specific function (see figure 14).

3.5.7.2.1.2 *Relay, lamp indexes (type II).* These indexes shall be prepared in tabular form for all relay coils and indicator lamps. The relay and lamp indexes shall include the item reference designation, the functional name, energizing voltage, and a reference to the troubleshooting diagram(s) (see figure 15).

3.5.7.2.1.3 *Protective device index (types II and IIS).* This index shall list all protective devices, such as fuses, circuit breakers, etc. The index shall include the item reference designation, front panel marking of the device, trip-out value of the circuit breaker and rating of fuses, name of the circuit protected and a reference to troubleshooting diagram(s) (see figure 15).

3.5.7.2.1.4 *Maintenance turn-on procedure (types II and IIS).* Include a maintenance turn-on procedure to energize the equipment from the fully de-energized condition to full operation (see figure 16). This procedure shall enable the technician to determine which major function or supporting function is malfunctioning. Each step of the procedure shall include the action to be taken (STEP), the observation to be made (OBSERVE), and shall assume that normal conditions have been observed in previous steps. Reference shall be made to the procedure for troubleshooting or corrective action to be used (REFERENCE) if the observation is out

of tolerance. Built-in monitors such as meters, dials, lamps, etc., shall be used when possible for making observations, as opposed to the use of external test equipment. The procedure is complete when the equipment is fully energized and all switches and controls are positioned for proper operation. The maintenance turn-on procedure may be presented in a troubleshooting dependency diagram (see 3.5.7.2.12).

3.5.7.2.2 *Troubleshooting procedures (types II and IIS).* Troubleshooting information shall be developed to guide a technician in the logical order of isolating a fault. This information shall direct the technician to observe meters, fuses, circuit breakers, valves, built-in test equipment, and other available indications showing the presence of trouble. The analysis of normal indications in relation to faulty indications should be stressed. This information may be in a tabular, illustrative or narrative format, whichever lends to faster troubleshooting. Test programs shall be developed for digital devices when the method is the most practical method of troubleshooting logic.

3.5.7.2.3 *Troubleshooting diagrams.* Troubleshooting diagrams shall consist of signal flow diagrams, piping diagrams, control diagrams, power distribution diagrams, logic diagrams, maintenance schematic diagrams, and dependency diagrams, as required.

3.5.7.2.3.1 *Signal flow diagrams.* Signal flow diagrams shall consist of detailed block diagrams illustrating the functional development of each equipment output from its origin to its measurable output (see figure 17). The flow path shall begin with one or more initial input (or appropriate interface conditions) and proceed through each unit, assembly and subassembly influencing the signal flow. Each hardware block shall reference a schematic diagram to isolate the faulty part. All items shown on the signal flow diagram shall be identified by their reference designations. The following shall apply.

a. Titles of diagrams shall correspond to the signal flow described.

b. Diagrams shall depict such signal flow as receive, transmit, RHI display, PPI display, bearing data, antenna rotation, elevation data, etc.

c. Show all test points necessary to isolate the trouble to the lowest level of hardware block (e.g., subassembly). Include test parameters required

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to define satisfactory operation. Where signal flow diagrams depict signal flow in more than one mode of operation, test data shall be presented on the apron for all modes. Apron notes shall also include test data for test equipment setup.

d. References shall be made to the functional description, troubleshooting procedures, corrective actions, etc., as appropriate by paragraph number. Normally these references shall be included with the notes.

e. The display of more than one function or mode of operation on one diagram shall be allowed only when clarity is not sacrificed and the functions are relatively simple.

f. Screwdriver adjustments, dial adjustments and adjustable controls shall be shown.

g. The reference designation (e.g., 1A1A2) shall be placed in each hardware block. Reference to the figure number of the schematic diagram shall be placed adjacent to the reference designation.

h. All input/output signals and connectors and terminals in the signal path shall be shown. Identify the signal, and show all lead numbers, connector numbers, and terminal identifiers.

i. All built-in controls and monitoring devices shall be shown. Do not show external test equipment, unless it is a permanent part of the equipment.

j. Hull grounds, chassis grounds, signal grounds, and power grounds shall be shown.

k. All leads of motors, generators, synchros, etc., shall be identified.

l. All relay coils that are energized by the signal shall be shown.

m. All relay contacts and relay terminals in the flow path shall be shown and identified. All relay contacts shall be depicted in the operational mode. References to control diagrams on which the relay coils appear shall be shown adjacent to the relay contacts.

n. All switches which affect signal flow shall be shown and identified. Switch terminals and panel markings corresponding to the switch positions shall also be shown.

o. Mechanical couplings of all controls, switches, potentiometers, synchros, etc., shall be shown.

p. Signal paths shall be identified by weighted lines and arrowheads.

3.5.7.2.3.2 *Piping diagrams.* Piping diagrams shall be prepared for fluid cooling, air, gas, and hydraulic systems. These diagrams shall show flow rate, temperature, pressure, and all devices which measure, control, or modify the flow (see figure 18). Also, a test data table shall be included on the apron. Reference shall be made to appropriate corrective actions and functional descriptions.

3.5.7.2.3.3 *Control diagrams (types II and IIS).* Control diagrams shall be included for all control circuits. Control circuits shall be grouped according to energizing voltage, control function, mode of operation, or physical limits of cabinet or assembly, as applicable (see figure 19). Supporting information required to clarify the use of the diagram shall be provided in the general notes. Include the functional name and reference designation for each relay, switch, lamp, etc., shown. All relay energizing circuits shall be shown with all tie points and terminals and with switches and relay contacts in their operating positions. All terminal connections, switches, interlocks, contacts, or other relays in series with the energizing path, plus lamps or indicators (electrically connected in the energizing or indicating status of contact closures), shall be shown. The following note shall appear on all control diagrams: "All switches and relay circuits are shown in operating positions."

3.5.7.2.3.4 *Power distribution diagrams (types II and IIS).* Power distribution diagrams shall depict the distribution of primary a.c. power, secondary a.c. power, and d.c. power from the terminal board, breaker, or fuse box to the various subassemblies or modules of the equipment (see figure 20). Normally, a separate diagram shall be prepared for each voltage level used within the equipment. The following rules apply in the preparation of power distribution diagrams:

a. Show and identify motors, transformers, regulators, power supplies, assemblies, subassemblies and modules.

b. Show and identify all power line devices such as fuses, circuit breakers, switches, and relay contacts.

c. Show and identify all connections including plugs, jacks, and terminal boards in the distribution path.

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d. Use dot and dash lines to set off hardware boundaries such as units, assemblies, and subassemblies. Identify each unit, assembly, and subassembly by reference designation. Include a figure reference to the schematic diagram covering the unit, assembly, and subassembly.

e. Reference all relay contacts to the appropriate control diagrams. All relay contacts shall be shown in the operating condition.

f. Include voltages and tolerances, as required.

g. Show and identify all metering circuits and indicators.

h. Show all grounds, commons, neutrals, and return lines.

i. Whenever practicable, power path is to be displayed from left to right and from top to bottom.

j. The functional names of all "main line" switches and circuit breakers shall be conspicuously marked on the diagram. In addition, set off any power control markings engraved or stencilled on the equipment in a rectangular box, for example,

MAIN POWER.

k. Show all relay coils in series with the main power distribution path. Relay control circuits shown on control diagrams need not be repeated on distribution diagrams.

l. The following note shall appear on all control diagrams: "All switches and relay circuits are shown in operating positions."

3.5.7.2.4 Maintenance schematic diagrams. Maintenance schematic diagrams shall include unit-to-unit interconnection diagrams, intra-unit interconnection diagrams, and unit, assembly, and subassembly schematic diagrams. Complete coverage of the equipment shall be provided by these diagrams (see figure 21). Maintenance schematic diagrams shall be prepared in accordance with MIL-M-38784 and the following:

a. The schematic diagram for each unit shall be drawn so that, together with the interconnecting diagrams, all circuit elements are included and all circuits can be traced from unit to unit.

b. Schematic diagrams shall be zoned by alphanumeric coordinates in accordance with 3.7.4.5. The location of all circuit elements by zones shall be included in a table located on the apron. When a part such as relay or a twin tube is drawn in

sections at different locations, list as many coordinates as necessary to locate all sections.

c. Represent major and minor signal paths by different line weights. The heavier line weight shall show the major signal path. Whenever signal flow shall be from left to right and from top to bottom. Arrowheads denoting the direction of signal flow shall be placed on the signal flow lines.

d. The use of ground and voltage buses is discouraged except in the power supply. However, voltage bus connections can be shown by broken lines directly beneath the connection. As a substitute for ground buses, individual grounds should be used and appropriate notes shall be included to indicate sources.

e. Show all significant voltages at buses, tube pins, transistor elements, etc., except when this data can be presented best in a voltage chart (see 3.5.7.2.4j). Indicate whether the voltage is a.c. or r.f.; d.c. voltages shall be shown by polarity.

f. The functional names of all operating controls and adjustments shall be conspicuously marked on the schematic. For example: VERT CENT, BIAS ADJ, etc. In addition, any operating front panel markings on the equipment shall be set off in a rectangular box. For example: **RF GAIN**, **AGC ADJ**. The functional name of all stages (tubes, transistors, etc.) also shall be included.

g. The function, source, and destination of all input and output circuits shall be identified and indicated by figure number.

h. Power and signal frequencies shall be designated in Hertz (Hz). Resistance values, if more than one ohm, shall be noted for all wire-wound devices such as motors, relay coils, and transformers.

i. Rated current and voltage values of primary and secondary windings of power transformers shall be indicated.

j. A resistance and voltage chart for a schematic diagram shall be provided on the apron. This chart shall give the normal resistance and voltage to ground (or other points of significance) for each tube socket pin. In addition, list all conditions which affect the resistance or voltage values given, such as control settings, equipment connections, tubes removed from sockets, etc. If semiconductors (transistors, diodes, etc.) are employed in circuits, adequate caution notices must be included to pre-

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vent damage to these devices when making resistance measurements in the circuit. No intra-element resistance measurements (i.e., between emitter, base, and collector) are required to be made on transistors themselves. Also, resistance of power supply buses and other points of significance shall be indicated.

k. Each schematic diagram shall be identified by the reference designation number, located in the lower right-hand corner of the image area.

l. Schematic diagrams shall be presented in alpha-numeric order corresponding to the reference designation of units, assemblies, subassemblies, etc. When two or more identical assemblies or modules are used, redundant schematic diagrams need not be repeated. However, a table which cross references the reference designation to the figure number of the common schematic diagram shall be provided immediately preceding the schematic diagram. Schematic diagrams covering more than one unit, assembly or module shall include in the lower right hand corner of the illustration (see figure 20), for identification purposes, all the reference designations of the unit, assemblies, and modules to which they refer. (For example, 1, 1A1, 2A7, 3A19.)

m. Circuit elements shall be grouped functionally and arranged to make signal flow obvious from left to right and top to bottom. Circuit elements shall not be arranged to fill up white space or to maintain tube or transistor alignment. Circuit elements shall be arranged in textbook form for the convenience of the user. Layout shall not be distorted to achieve fit.

3.5.7.2.5 *Logic diagrams.* Logic diagrams shall be provided for digital devices and digital aspects of conventional equipment (see figure 22). Logic diagrams shall conform to MIL-M-38784.

3.5.7.2.6 *Control cycle diagram.* Control cycles of digital equipment shall show the entire cycle on a single signal flow logic diagram together with an appropriate note describing key operating features (see figure 23).

3.5.7.2.7 *Timing circuits diagrams.* Timing circuits diagrams shall be provided for all significant timing relationships (see figure 24). These diagrams shall show the exact timing relationships and the origins of all timing signals (conventional and digital).

3.5.7.2.8 *Single-function diagrams.* Logic diagrams for nonprogrammable devices which result in a unique output function may be prepared to the requirements of signal flow diagrams (see 3.5.7.2.3.1)

3.5.7.2.9 *Module logic diagrams.* Module logic diagrams shall be provided for all modules

3.5.7.2.10 *Flow charts (types II and IIS).* Flow charts for digital devices shall be provided to support the explanation of machine instructions and test programs, and shall conform to USAS X3.5.

3.5.7.2.11 *Coding instruction sheets.* Coding instruction sheets shall be provided for all programs. The listing shall contain all coding and address data as well as an adequate notes section to ensure understanding (see figure 25).

3.5.7.2.11.1 *Test programs.* Test programs with coding instruction sheets shall be developed and included to support troubleshooting procedures.

3.5.7.2.12 *Troubleshooting dependency diagrams.* One of the following types of troubleshooting dependency diagrams shall be provided to augment the troubleshooting procedures.

3.5.7.2.12.1 *Troubleshooting functional dependency diagram (type II).* A troubleshooting functional dependency diagram (TFDD) is a block diagram which illustrates the functional dependency of one test point (or circuit) upon another (see figure 26). The TFDD is arranged in pyramid fashion. Vertical chains of boxes (geometric outlines) shall represent contributing branches of signal development. Series connection of boxes (vertically) shall depict continuity of each signal path through successive dependency levels. The box at the top, or apex, of the TFDD shall represent the function output of the equipment and shall reflect the result of all boxes illustrated below it. An in-tolerance indication by all signal characteristics of the apex box shall represent an acceptable condition of all boxes below it. However, if any characteristic of the apex box is out of tolerance, then one or more of the characteristics in boxes below the apex box must be found unacceptable. Each functional dependency box shall contain identification of the test point and its location, and shall reference the specific notes contained on the apron of each diagram. Functional dependency boxes shall be of consistent width, but adjusted in height to accommodate

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the material to be contained in them. Where a series of functional dependency boxes result in a chain that exceeds the height for the image area of the sheet, the chain may be broken into suitable lengths and the subordinate sections displayed in successive columns to the right. In these cases, the head of the subordinate column will be staggered so as not to occupy the same horizontal line as the higher-level boxes. A larger TFDD may be broken as required to fit on two or more sheets. To number functional dependency boxes on a TFDD, begin at the top level and number from left to right in ascending numerical order. Test points on the corresponding signal flow diagram shall be numbered in accordance with the same sequence.

3.5.7.2.12.2 Fault logic diagrams. Fault logic diagrams shall be based on a fault indication observed during troubleshooting (see figure 27). The diagrams shall comprise a branching series of questions pertaining to fault isolation. Each question shall pertain to a further observation or measurement, and shall result in a "yes" or "no" answer, thereby progressively narrowing the possible functional area of the fault. Tolerance values shall be presented in those instances where a definitive "yes" or "no" is not obtained. This progression and elimination shall isolate the functional area of the equipment containing the fault and then refer the user to the portion of the manual containing that information needed to complete the fault isolation and repair. Each diagram shall include or make reference to information necessary to establish the test or operating conditions required for starting the fault isolation procedure. Only three types of blocks shall be used. Shaded blocks (right and bottom border lines weighted) shall contain questions which may be answered from observation, without changing test setup and without special equipment. Single-line blocks shall contain questions requiring measurement by special setup of external test equipment. Double-line boxes (conclusion boxes) shall list the functional area within an equipment that is the probable source of malfunction and shall reference a procedure or another diagram for further isolation or correction of a fault.

3.5.7.2.12.3 Troubleshooting - maintenance dependency-matrix chart. Matrix charts shall

show the functional dependency of output signals or indications upon circuit elements, circuits, modules, etc. (see figure 28). These charts shall be presented in the form of a grid, as follows:

a. Each vertical column is annotated to represent a circuit element, circuit, module, etc.

b. The horizontal rows are annotated to represent a procedural step which results in an observable output or indication.

c. Symbols shall be used, in the body of the grid, to show the relationship between circuit elements, circuit, etc., and observable output or indication.

d. All circuits, modules, etc., shall be exercised in a manner to permit logical diagnosis.

e. All outputs shall be clearly defined and performance specifications given.

f. All symbols shall be defined.

g. Use of the chart shall be fully explained.

3.5.8 Chapter 6, Corrective maintenance. This chapter shall contain instructions required to adjust and align the equipment, remove, repair, reinstall, and align all repairable parts, modules, subassemblies, and assemblies. The instructions shall identify the action to be accomplished; safety precautions to be observed; tools, parts, materials, and test equipment required; preliminary control settings; test equipment set-up instructions; and step-by-step instructions, with supporting illustrations, to accomplish the maintenance task.

3.5.8.1 Introduction. The introduction shall contain an explanation of the purpose, scope, and arrangement of the corrective maintenance data.

3.5.8.2 Section 1, Adjustments and alignment. This section shall contain all information and procedures required to perform all necessary adjustments and alignments as follows:

a. Nonoperator type tuning and adjustment (type II manual).

b. Alignments requiring external jigs, test equipment, or bench setups.

c. Alignments that are accomplished after a repair or replacement of a part or module.

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d. Test equipment set-up and other illustrations necessary to support the procedures.

3.5.8.3. Section II, Repair. The repair section shall contain all procedures required in the repair of assemblies and repairable parts. Repair procedures shall include but not be limited to the following:

- a. Removal, disassembly, and inspection.
- b. Repair or replacement of piece parts.
- c. Cleaning, reassembly, adjustment, installation, calibration and checkout.
- d. Exploded views, sectional views, wiring diagrams, and photographs necessary to support the procedures.

e. Obvious repair actions such as soldering, use of multimeters, hand tools, etc., shall not be included except where these actions involve hazards to personnel or equipment.

f. *Type II manual.* Repair procedures shall be arranged in numeric-alpha unit designation order of the equipment.

3.5.9 Chapter 7, Parts list. The parts list shall list and identify all shipboard, tender, and shore-based repair parts including attaching hardware. This chapter shall include the following:

- a. Introduction.
- b. List of major components (type I) or list of major units (type II).
- c. Parts list.
- d. List of common item descriptions.
- e. List of attaching hardware.
- f. List of manufacturers.
- g. Parts location illustration.

3.5.9.1 Introduction. The introduction shall contain an explanation of the scope and arrangement of the parts list. The following type of information shall be included:

- a. Models of equipments and serial numbers of equipments covered.
- b. Explanation of any special notes.
- c. Explanation and instructions for using the list of common item descriptions (type II).

d. Explanation and instructions for using the list of attaching hardware (type II).

e. Explanation and instructions for using the parts list.

f. Explanation and use of the list of manufacturers.

3.5.9.2 List of major components or major units. A list of major components or a list of major units in tabular form shall be included as specified in 3.5.9.2.1 and 3.5.9.2.2.

3.5.9.2.1 List of major components (types I and II). A list of major components in tabular form shall be included similar to the following:

a. *Column 1, CID number.* This column shall list the CID number for each major component, if available.

b. *Column 2, Quantity.* This column shall list the quantity of components.

c. *Column 3, Name (type II).* This column shall contain the official name of the major components.

3.5.9.2.2 List of major units (type II). A list of major units in tabular form shall be included as follows:

a. *Column 1, Unit number.* This column shall list unit numbers for each major unit.

b. *Column 2, Nomenclature.* This column shall be subdivided into the following:

(1) *Name of unit.* This column shall list the official name of the unit.

(2) *Designation.* This column shall list the type number of the unit.

c. *Column 3, Page number.* This column shall list the number of the first page of the parts listing for the major unit.

3.5.9.3 Parts list requirements.

3.5.9.3.1 Parts list (type I). Parts listing shall be prepared in tabular form similar to the following (see figure 29):

a. *Column 1, Figure and index number.* This column shall contain the figure number and index number which shows the location of the part.

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b. *Column 2, Part number.* This column shall contain the part number or engineering drawing-index number.

c. *Column 3, Description.* This column shall contain the designated name of the part with a brief description indicating its use and the military or manufacturer's specification number (e.g., Cylinder Assembly, Drive Flap, Actuating, Dormer Company 669066). Attaching hardware, with quantity required, shall be identified. Subassembly parts shown on different figures shall reference the figure.

d. *Column 4, Notes.* This column shall contain component information such as serial number, model number, configuration data, etc. When footnotes are used, reference the footnotes.

3.5.9.3.2 *Parts list (types II, IIS, and IIX).* The parts list shall be divided and arranged by major units in numerical sequence (e.g., unit 1 with its parts, etc., will precede unit 2 with its parts). All parts attached to the unit shall be listed first in alpha-numerical order, followed by unit assemblies with parts and subassemblies with parts, also listed in alpha-numerical order as follows:

Unit	1
(Cabinet	1AT1
parts)	1B1
	1C1
	1CR1
	1R1
	etc.
Assembly	1A1
(Assembly	1A1AT1
parts)	1A1B1
	1A1C1
	1A1CR1
	1A1R1
	etc.
Subassembly	1A1A1
(Subassembly	1A1A1AT1
parts)	1A1A1B1
	1A1A1C1
	1A1A1CR1
	1A1A1R1
	etc.
Unit	2
	etc.

3.5.9.3.2.1 Parts listings shall be prepared in tabular form with columns headed as follows (see figure 30):

a. *Column 1, Reference designation.* This column shall contain the reference designations of all parts listed in sequential order. The unit numbering method of assigning reference designations, as specified in USAS Y32.16, shall be used to identify units, assemblies, subassemblies, and parts. The parts list shall be divided and arranged by major units in numerical sequence (e.g., unit 1 with its parts will precede unit 2 with its parts, etc.). When reference designations have been cancelled for more than two consecutive items, only the first and last of the designations are to be listed, separated by the word "through." For example: 3A1R69 through 3A1R100 not used.

b. *Column 2, Notes.* This column shall contain equipment reference information such as serial number, model number, configuration data, etc.

c. *Column 3, Name and description (type II).* This column shall include descriptive data to identify the parts of the equipment and aid in determining substitutes. Such information shall consist of the name, the electrical characteristics, and military type number of the item. Those parts not having a military type number shall also include physical characteristics (material and sufficient dimensions) to identify the parts within the set. For identical parts that are used more than five times in the equipment, the complete item description shall be given in the list of common item descriptions and reference made thereto by the item number. Following the item description, the equipment contractor's part number, manufacturer's part number, part manufacturer's Federal supply code number, and military type designation, as applicable, shall be included in the part description column. Attaching hardware (type II only), with quantity required, shall be identified by the assigned letter code (see 3.5.9.5). For example, C(4) would be the third listed piece of attaching hardware in which four pieces are used.

d. *Column 4, Figure and item number.* This column shall reference the parts location illustration (see 3.5.9.7) by figure number and item number enclosed in parenthesis (e.g., 6-119(17)).

3.5.9.4 *List of common item descriptions (type II).* This list shall include the description of all multiple use parts (over five applications). The description shall contain the same information specified in 3.5.9.3.2.1. Like parts should be grouped and arranged in alphabetical order. Item numbers shall be assigned consecutively, for example:

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<i>Item number</i>	<i>Description</i>
1	CAPACITOR, FIXED, CERAMIC: DIELECTRIC 3PF, 500 VDCW; MIL type CCZ1UJ030C.
2	CAPACITOR, FIXED, GLASS: DIELECTRIC 5100 PF, $\pm 1\%$ 300 VDCW, mfr 86969, dwg 231B743H15
3	RESISTOR, FIXED, COMPOSITION: 3000 ohms $\pm 5\%$ 1/2w; mfr 42384, dwg 4469D69
4	RESISTOR, FIXED, COMPOSITION: 4000 ohms $\pm 5\%$ 1/2w; MIL type RC20GF402J

3.5.9.5 *List of attaching hardware (type II).* A list of standard attaching hardware shall be included which shows items of attaching hardware used in five or more applications. For example:

<i>Letter code</i>	<i>Name and description</i>
A	SCREW, CAP, HEX HEAD, DRILLED HEAD, CRES: MS51100-8 1/4-28, UNF-2A, 1 in lg.
B	WASHER, FLAT, STEEL, ROUND, .750 in ID, .312 in OD, .066 in thickness.

Items used fewer than five times need not be included in the index, but should be completely identified in the parts list.

3.5.9.6 *List of manufacturers.* The list of manufacturers shall contain the names, addresses, and code symbol of all manufacturers supplying items for the equipment as referenced in the parts list. The list shall be presented in numerical sequence by code number. Code numbers shall be in accordance with Handbooks H4-1 and H4-2.

3.5.9.7 *Parts location illustrations.* Illustrations shall be included to provide positive and rapid location of parts. Types of parts location illustrations include exploded views (figure 31), engineering drawings (figure 32), photographs (figure 33), and sectional views, as applicable. (Suitable parts location illustrations located in other chapters of the manual may be referenced.)

3.5.9.7.1 *Criteria for illustrations.* Items shall be called out on illustrations by call-out leader, index number, or grid coordinates. Standard attaching hardware items (such as nuts, bolts, washers, screws) need not be called out or illustrated (except on exploded views) unless they are referenced

in a procedure. Illustrations required for repair and replacement in chapter 6 need not be repeated but shall be referenced.

3.5.9.7.2 *Exploded views.* Parts in an exploded view shall be arranged in correct relative disassembled position and shall be shown in proportional size (see figure 31). The spacing of parts shall achieve maximum clarity and effective use of space. The relationship of parts shall be shown by the use of assembly lines where the main line of exploded parts has been broken into two or more groups for convenience of layout on the page. Leader lines and index numbers shall be used to assist in locating parts.

3.5.9.7.3 *Line drawings and photographs.* Line drawings are preferred to photographs, where practical. Engineering drawings are acceptable if they meet the format and content requirements of this specification and the legibility requirements of MIL-M-38784. Figure 32 is a typical line drawing and figure 33 is a typical photograph.

3.5.10 *Chapter 8, Installation.* Drawings and information concerning installation shall be provided in this chapter. The following type of information shall be included: site selection, special tools and materials requirements, unpacking, and handling (if unusual procedures or precautions are required), preparation of foundations, mechanical assembly procedures, mounting instructions, bolting diagrams, safety precautions, grounding and bonding, clearances for access, ventilation, fluid cooling requirements, clearances for motion under shock, and recommendations for reduction of electrical and electromagnetic interference, and other interface requirements, as applicable. In addition, this chapter shall contain tests and test procedures required to demonstrate that the equipment after installation is capable of satisfying operational requirements.

3.5.10.1 *Installation drawings.* Legible reproductions of appropriate installation drawings in accordance with category G of MIL-D-1000 and MIL-D-1000/2 shall be provided, as follows:

- a. Pictorial system diagram.
- b. Outline and mounting dimension diagrams.

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c. Interconnecting wiring and cabling diagram.

d. Summary list of installation material.

e. Piping diagram.

In addition, reference shall be made to the Cable Running Sheets by drawing numbers.

3.5.10.2 Site information. This data shall contain information supplemental to the installation drawings. If all site information is contained on the installation drawings, reference shall be made to the applicable drawing(s) by figure number.

3.5.10.3 Reference publications. Reference shall be made to general publications required to complete the installation.

3.5.10.4 Tools and materials required for installation. Include information supplemental to the summary list of installation material. If no supplemental information is required, reference the drawing by figure number.

3.5.10.5 Unpacking and repacking. Include information supplemental to the installation drawings regarding unpacking and repacking. Include step-by-step procedures to prevent damage to the equipment or injury to personnel. Supporting illustrations shall be provided to clarify procedures. When packing for reshipment is required, step-by-step procedures for packing shall be included and illustrated. When packing is simply the reverse of unpacking, this fact need only be stated. Any special environmental conditions required for storage shall be provided.

3.5.10.6 Preparation of foundations. Include information supplemental to the installation drawings. If all foundation preparation information is contained on the installation drawing, refer to the drawing(s) by figure number.

3.5.10.7 Input requirements. A summary of the input data contained on the installation drawings shall be included. Parameters with tolerances should be included with each of the inputs listed. Examples of inputs are as follows:

- a. Power.
- b. Ventilation.

c. Dry air (waveguide pressure).

d. Ship gyro information.

e. Fluid cooling.

f. Steam.

g. Freon.

3.5.10.8 Installation procedures. The following types of supplemental information which is not provided on the installation drawings shall be included:

- a. Instructions required to assemble units.
- b. Instructions required to mount units. Include bolting and bracing diagrams and data on shock mounts.
- c. Instructions for making electrical, plumbing, transmission line and all other interface connections (external) to the equipment.
- d. Instructions for interconnecting units comprising the equipment.
- e. Servicing procedures, such as initial lubrication.
- f. Instructions for bonding and grounding.

3.5.10.9 Installation checkout. Provide step-by-step procedures to demonstrate that the equipment operates correctly and within tolerances. These procedures shall provide for equipment checkout in three test phases as follows:

- a. *Phase 1*—Installation inspection and pre-energizing procedures.
- b. *Phase 2*—Turn-on and preliminary tests.
- c. *Phase 3*—Installation verification test.

3.5.10.9.1 Phase 1—Installation inspection and pre-energizing procedures (types II, IIS, and IIX). Provide inspection procedures in the form of check lists to verify the following:

- a. That all units of the equipment and required auxiliary equipments have been installed and that their location and orientation is proper; that all cables, antennas, waveguides, transmission lines, dehydrators, coolant lines, piping, etc., have been installed in accordance with plans and specifications; that continuity exists in all interconnections.

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b. That the test equipment listed in chapter 1 is onboard, operating satisfactorily, and has been calibrated.

c. That the Allowance Parts List (APL) is onboard, that the Coordinated Shipboard Allowance List (COSAL) includes the equipment data.

d. That all field changes, shipalts and mandatory retrofits have been accomplished.

e. That all rotating devices are free from obstruction.

f. That there is access to the equipment for maintenance.

g. That all pre-energizing servicing procedures, including lubrication have been accomplished.

h. That it is safe to turn on the equipment.

3.5.10.9.2 *Phase 2—Initial turn-on and preliminary test (type II)*. Include procedures for energizing the equipment for the first time. This may be accomplished by reference to the applicable portions of chapter 2. Include step-by-step procedures for testing the equipment electrical supply circuits including distribution panels, switches, breakers, relief valves, and interlocks. Include procedures for testing piping, electrical cables, wire rope, stays, for proper installation of transmission lines and waveguides, hangar spacing, torquing of connectors, pressure testing, flow rates, standing wave ratio and attenuation checks, etc.

3.5.10.9.3 *Phase 3—Installation verification test (type II)*. Include complete instructions for testing the equipment in all modes of operation. Where applicable, refer to the scheduled performance tests in chapter 4. Procedures shall cover checking gages, meters, alarms, and other sensing devices for proper operation and calibration. The tests shall verify that all inputs are in tolerance. Where applicable, include voltage standing wave ratio (VSWR) and insertion loss tests to verify the proper installation of antenna-to-equipment waveguide runs; transducer impedance and source level checks to verify proper installation of transducers, domes, and cables. Preliminary setup data shall be included in each procedure. When it is required that an alignment be accomplished prior to performing a test, the alignment shall be included or referenced in the procedure.

3.5.10.9.3.1 *Test procedure*. Testing procedures shall be presented in a logical order as follows:

a. Energize the equipment.

b. Test the first units (normally power supplies) which must be operating properly. When test results are within the required tolerance, include reference to the next logical test. Include a reference to the corrective maintenance or troubleshooting data to be used if test results are not within tolerances.

3.5.10.9.3.2 *Installation standards summary sheet (type II)*. The installation standards summary sheet shall provide spaces for recording the results of all installation verification tests (see figure 34). Each space shall be identified by the step or paragraph number which provides the instructions for accomplishment. Each space shall contain the respective unit of measurement (e.g., amp., db., or v.). When applicable, waveforms shall be included to show the points on the pattern where the measurement is to be taken. In addition, critical installation data shall be included, such as the length of the transmission line.

3.5.11 *Type IIS and type IIX manuals*.

3.5.11.1 *Type IIS manuals for service test equipment*. Type IIS manuals for service test equipment shall conform to the production requirements of 3.8.6 and to the content requirements for type II manuals except that the following data need not be supplied:

a. Descriptions of circuits in NAVSHIPS 0967-000-0120 (3.5.5.2.c)

b. Scheduled maintenance action index (3.5.6.2)

c. Reference to troubleshooting actions (3.5.6.4.h)

d. Troubleshooting index (3.5.7.2.1.1)

e. Relay, lamp indexes (3.5.7.2.1.2)

f. Control diagrams (3.5.7.2.3.3)

g. Troubleshooting dependency diagrams (3.5.7.2.12)

h. Attaching hardware data (3.5.9.3.2.1c and 3.5.9.5)

i. Phase 1—installation inspection and pre-energizing procedures (3.5.10.9.1)

3.5.11.2 *Type IIX manuals for experimental equipment*. Type IIX manuals for experimental equipment shall conform to the production requirements of 3.8.6 and the content requirements for type II

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manuals except that the following data need not be supplied:

- a. Descriptions of circuits in NAVSHIPS 0967-000-0120 (3.5.5.2.c)
- b. Scheduled maintenance action index (3.5.6.2)
- c. Reference to troubleshooting actions (3.5.6.4.b)
- d. Troubleshooting index (3.5.7.2.1.1)
- e. Relay, lamp indexes (3.5.7.2.1.2)
- f. Protection device index (3.5.7.2.1.3)
- g. Maintenance turn-on procedure (3.5.7.2.1.4)
- h. Troubleshooting procedures (3.5.7.2.2)
- i. Control diagrams (3.5.7.2.3.3)
- j. Power distribution diagrams (3.5.7.2.3.4)
- k. Flow charts (3.5.7.2.10)
- l. Troubleshooting dependency diagrams (3.5.7.2.12)
- m. Section II, repair (3.5.8.3)
- n. Attaching hardware data (3.5.9.3.2 and 3.5.9.5)
- o. Phase I—installation inspection and pre-energizing procedures (3.5.10.9.1)

3.6 Technical contents for systems manuals (type III).

3.6.1 Specific requirements. Type III manuals shall provide system-oriented instructions (see 6.5.18) for operation, maintenance, installation, and test data. Detailed equipment data should be provided by reference to the equipment manuals. However, technical data shall be developed at the equipment level and be included for all equipment not covered by an equipment technical manual. The contents shall be arranged in chapters according to the following:

- Chapter 1—General Information
- Chapter 2—Safety Precautions
- Chapter 3—Conditions of Readiness
- Chapter 4—Operation
- Chapter 5—Functional Description
- Chapter 6—Scheduled Maintenance
- Chapter 7—Fault Isolation
- Chapter 8—Alignment Procedures
- Chapter 9—Installation Data

3.6.2 Chapter 1, General information. Chapter 1 shall describe the system in general physical and functional terms as specified in 3.6.2.1 through 3.6.2.5.

3.6.2.1 Introduction. The introduction shall define the system and its relationship with other systems. The mission of the system shall be stated. The text shall be supported by a diagram(s) showing the interrelationships of the system equipments (see figure 35). The major functional relationship and inputs and outputs to related systems shall be indicated.

3.6.2.2 Physical arrangement. System areas and compartments shall be described and the system equipment and units contained in the areas shall be listed. The physical arrangement description shall be supported by the following illustrations:

a. An inboard profile drawing of the ship or stations showing compartment locations and identifying topside equipment and equipment units comprising the system (see figure 36).

b. Separate illustrations of each compartment and area, identifying the listed system equipment (see figure 37). Other equipment, which is installed in the subject system compartments and areas, need not be listed in the text or called out in the illustrations if they do not directly affect the operation or maintenance of the subject system.

3.6.2.3 System equipment. Each of the equipments comprising the system shall be identified and described. Descriptions of operator-attended equipment shall include general statements as to the nature and purpose of units and indicators. The text shall be supported by illustrations. All equipments shall be shown, whenever possible, in relative-scale proportion. An equipment may be separately illustrated with significant features called out, if such details are necessary for proper support of the text.

3.6.2.4 Associated-system equipment. When required, descriptions and illustrations of associated-system equipment shall be limited to the major units thereof. The descriptions shall be more condensed than those of subject system equipment; otherwise, the same requirements are applicable. In the descriptions,

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emphasis shall be placed on those associated systems equipments that constitute operational or functional interfaces with the subject system. Such units shall be included in the system illustrations.

3.6.2.5 Reference data. Reference data shall include a list of the equipment comprising the system, and its official designations. A list of common names and abbreviated or informal nomenclature, and system characteristics together with a list of referenced publications shall be included as follows:

a. *Capabilities.* A summary of system capabilities shall be provided. The summary shall include data such as gallons per minute, transfers per hour, boom capacity, rated ranges, resolution, accuracy, data handling capability, number of channels, etc. Such data should be presented in tabular form.

b. *Reference publications.* A list of the manuals that pertain to system and system equipments, and other documents of interest, such as training manuals and manuals for associated systems equipment shall be included. The list of publications shall include the title and publication number of the referenced publications.

c. *Tools and test equipment.* A list of all special tools and test equipment for system-level maintenance shall be included. Special tools are defined as those tools not listed in the Federal Supply Catalog (copies of this catalog may be consulted in the office of the Defense Contract Administration Service (DCAS)). An illustration and description of special items required shall be provided for identification. Information shall be presented in tabular form. For each item the description or table shall include:

- (1) The official name or nomenclature.
- (2) Identifying number.
- (3) A brief description of the use of the item with a reference to the procedure(s) requiring its use.

3.6.3 Chapter 2, Safety precautions. Chapter 2 shall describe the hazards associated with system operation and maintenance. To permit wide and unrestricted use onboard ship, chapter 2 should contain only unclassified information.

3.6.3.1 Introduction. This description shall orient system supervisory personnel, and shall include the following:

- a. Purpose, scope and organization of the system safety instructions.
- b. Basic safety concepts.
- c. Basic responsibilities for safety.

3.6.3.2 Electromagnetic radiation hazards and precautions. If applicable, describe the radiation hazards to topside personnel and the precautions to be taken. The hazards of radiation to flammable or explosive materials also shall be described. The description shall include discussions of the following:

- a. Locations of topside and inboard radiation hazardous areas.
- b. Minimum safe distances on the axis of beam radiation.
- c. Precautions to be taken when entering areas of radiation hazard (such as the wearing of copper-screen goggles).
- d. The effect of radiation on flammable or explosive material such as induction of rf currents in metals, sparking, and the consequent possibility of igniting flammables or detonating explosives. The text shall be supported by one or more illustrations identifying the areas of radiation hazards and the location of antennas, etc.

3.6.3.3 Hazards to divers. When applicable, the description of hazards to divers shall include but shall not necessarily be limited to the following:

- a. The nature and intensity of sound energy in water as related to divers.
- b. Precautions to be taken when working near operating equipment.
- c. Illustrations identifying the hazardous areas and locations of sonar domes.

3.6.3.4 System hazards and precautions. Include descriptions of system hazards and precautions, addressed to system personnel and referenced to particular system equipments. The descriptions shall be organized to be consistent with the operation of the system. The descriptions shall supplement and extend equipment safety instructions to the system

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level, by warning of potential hazards that can be caused during operation or maintenance.

3.6.3.4.1 Operational safety summary. A summary shall be included which emphasizes the proper use of equipment controls, describes the hazards to operators, or as applicable, the hazards to persons in areas remote from the operation, and recommends precautions. An emergency operational routine shall be included which emphasizes the controls that permit immediate braking or deenergizing of the system.

3.6.3.4.2 Maintenance safety summary. A maintenance safety summary shall emphasize the proper use of controls, describe the hazards to maintenance personnel, potential damage to the equipment, and recommend precautions.

3.6.3.4.3 Hazardous components. Identify and briefly describe the hazardous components including radioactive devices and elements used with the system and summarize the general handling precautions for such components. The description of a hazardous component shall include brief statements as to the purpose, manner of functioning, nature of built-in safety devices, and nature of the hazardous element; it shall also indicate the relative sensitivity of the component to mechanical shock, vibration, electromagnetic and radioactive radiation, and electrostatic discharges.

3.6.4 Chapter 3, Conditions of readiness. This chapter shall be provided for guidance purposes and shall represent engineering considerations. Chapter 3 shall list conditions of readiness requirements prior to the operation of the system. Activities or conditions within compartments or areas outside the system shall be described as necessary.

3.6.4.1 Conditions coverage. An orientation of system personnel shall be included. The condition of readiness shall be included as follows:

Watch condition
General quarters condition
Emergency condition

Coverage shall include but not be limited to the following:

a. A block diagram showing signal paths of the conditions of readiness (see figure 38).

b. Block diagrams and descriptions of interior communications links between compartments and areas, including sound-powered telephone circuits, announcing systems, and closed-circuit television.

c. Presumptions relative to systems status at specified times. (For example, from watch condition to general quarters conditions, or from general quarters condition to emergency condition).

3.6.4.1.1 Watch condition. Describe the condition of all systems equipment and the personnel situation for watch condition. The operating console and panel positions shall be illustrated.

3.6.4.1.2 General quarters condition. Describe the condition of all systems equipment and personnel situation for general quarters condition. The operating control and panel positions shall be illustrated.

3.6.4.1.3 Emergency condition. Describe the condition of all systems equipment and the personnel situation for emergency condition. The operating console and panel positions shall be illustrated.

3.6.5 Chapter 4, Operation. Chapter 4 shall describe system operating situations, modes, and procedures. The descriptions shall be detailed to the level required for an understanding of the operational interfaces of the system equipments and associated systems. Illustrations shall be included when necessary for clarity (see figure 39). The various operating modes shall first be described to acquaint the operator with all equipment combinations that can be employed to effect a given mode of operation.

3.6.5.1 Preoperational conditions and setup. Establish specific preoperational conditions presumed to be in effect prior to system operation. A system readiness checkoff list of significant switch positions and indicator status shall be tabulated. For indicators such as dials, where a band of readings are possible, upper and lower limits shall be delineated. The initial conditions of associated-system equipment that directly affect system operation should be treated in a similar manner.

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3.6.5.2 Operating modes. The primary operating mode shall be discussed in detail, and alternate modes shall be treated as modifications of the primary mode. Operating procedures common to all modes shall be detailed under the primary mode and referred to under the alternate modes, with such modifications of procedure as may be necessary. Each mode shall be described in the logical sequence of major phases, events, options, supervisory commands, and responsive actions and the following:

a. Only those equipment operational controls and indicators having system significance shall be explained in the description. When controls must be actuated and indicators observed in a sequence to achieve system operation, the descriptions will cite each control and indicator with a number to indicate the position in the sequence.

b. Emphasis shall be placed, by the use of warnings on the safe operation of controls, which, if operated improperly, could result in hazards to personnel or damage to the equipment. Each control shall be followed by a brief description of its effects (equipment actuation or display indication, or both) at the operator station and at remote stations. The primary mode description shall be supported by both general and detailed illustrations.

c. Operational phases which involve operator judgment shall be illustrated by operational logic diagrams. The diagrams shall indicate the conditions that must be favorable prior to an operator action, or if unfavorable, indicates the alternate action. Illustrations showing dials, gages, status lights, etc., which indicate the favorable or unfavorable conditions shall be included. Special procedures to be followed when an equipment failure may be bypassed (as separate from emergency procedures) shall also be described.

3.6.5.2.1 Normal operation. The duties of system operators shall be described in terms of general responsibility and specific step-by-step procedures for operating the system in all of the primary modes. Descriptive words (such as switch, button, dial, or indicator) may be added to clarify the type of control involved, for example: "Press ACCESS button and observe channel spot." All system con-

trols and indicators provided for the use of operators shall be covered. Controls and indicators provided only for maintenance and nonsystem application shall not be called out.

3.6.5.2.2 Emergency operation. Step-by-step procedures shall be provided for emergency operation of the system. If specially designated controls have been provided for emergencies, a short statement shall be included describing how they modify or otherwise affect normal system operation. Emergency procedures shall be supported by illustrations.

3.6.5.2.3 Special operation. Special operations such as test checkout, training, or evaluation exercises shall be described. Illustration support shall include block diagrams and pictorial diagrams.

3.6.6 Chapter 5, Functional description. Chapter 5 shall describe how the components or equipments comprising the system, jointly perform major operations and functions, and how associated systems contribute to the performance of these major functions. Equipment or associated system interfaces shall be described only as necessary to identify the sources or destination of system inputs and outputs (see figure 40). Descriptions shall not repeat the functional description provided in the equipment manuals.

3.6.6.1 Method of presentation. The presentation shall first define how the system major functions meet the purpose of the system as described in 3.6.2.1. Each major function shall then be discussed separately at progressively increasing levels of detail. The description of the entire system shall be supported by a basic block diagram of the system (see figure 41). Where information can be presented better pictorially than by text, additional diagrams and other illustrations shall be used. Reference may be made to diagrams appearing in chapter 7.

3.6.6.2 Introduction. The introduction shall describe the general approach that is used in the functional description. The introduction shall also describe briefly the interrelationship between the system and associated systems.

3.6.6.3 System function directory. A system function directory shall tabulate operation control functions and the signal data described in the detailed level of functional

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analysis (see 3.6.6.6). The tabulation shall include the following information, as applicable:

a. Official name of the function, colloquial name, and symbol.

b. Type of control or signal (a.c. frequency and voltage, d.c. polarity and voltage, hydraulic pressure, mechanical motion, synchro, etc.).

c. The origin and termination of the control or signal.

d. Identity of equipments (relay transmitters, coordinate converters, distribution boxes, switches, and the like) between the origin and termination of the output control or signal.

e. Figure numbers of illustrations on which the function is illustrated, including the fault isolation diagrams in chapter 7.

3.6.6.4 Functional description. Each function shall be described by at least two levels of detail.

3.6.6.5 First level of functional description. The first level of the description shall be confined to data such as origin of the function at an equipment control or sensor; transmission of the signal via intermediate equipment such as switchboards, relay transmitters, coordinate converters, and distribution boxes; and presentation of the function at terminal equipment. Control functions essential to the development of a signal shall be introduced and briefly described in their relationship to the signal. The description shall be supported by a block diagram (see figure 42). The diagrams for electrical/mechanical systems may be illustrated as shown on figure 43. Functions involving computations may be explained in mathematical terms, but at a level no higher than high school mathematics. The second level of analysis shall be supported by one or more diagrams.

3.6.6.6 Detailed (second) level of functional description. The detailed-level description shall explain the system functions in terms directly related to the diagrams in chapter 7. Data and control functions shall be described down to the level of an equipment or an equipment group. Functional descriptions of im-

portant parts of electrical/mechanical systems may be supported by illustrations similar to figure 44.

3.6.7 Chapter 6, Scheduled maintenance. Chapter 6 shall contain all system scheduled test procedures, together with necessary explanations and illustrations. Chapter 6 shall comprise the following:

a. Introduction.

b. Scheduled maintenance action index.

c. Scheduled test procedures.

3.6.7.1 Introduction. The introduction shall be an explanation of the purpose, scope, and arrangement of the scheduled maintenance material. When a preventive maintenance procedure is critical to the operation of the system and the schedule for servicing is absolute (not recommended), this information shall be conspicuously written as a CAUTION. The following statement shall be included: "The scheduled maintenance instructions in this manual are cancelled when the Planned Maintenance Subsystem (PMS) is implemented for this system aboard your ship or station."

3.6.7.2 Scheduled maintenance action index. This index shall include all required scheduled performance tests. The index shall be tabulated as follows:

a. **Column 1, Periodicity.** This column shall contain a list of all scheduled actions contained in the chapter. The following periodicity symbols, as appropriate, shall be used:

Interval	Symbol
Daily -----	D
Weekly -----	W
Monthly -----	M
Quarterly (3 months) -----	Q
Semiannually (6 months) -----	S
Annually (12 months) -----	A
Overhaul cycle -----	C
As specified (explain circumstances) -----	R

b. **Column 2, Maintenance action.** This column shall list the title of the maintenance action which corresponds to the periodicity number in column 1.

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c. *Column 3, Reference.* This column shall state the paragraph or table number of the maintenance procedure that corresponds to the maintenance action listed in column 2.

3.6.7.3 *Scheduled test procedures.* Include the detailed procedures for setting up and performing complete system tests. Each procedure shall be numbered and titled to clearly define the test action and the output to be tested. The procedures shall contain the data specified in 3.5.6.4.

3.6.8 *Chapter 7, Fault isolation.* Chapter 7 shall contain fault isolation procedures, illustrations, and an explanation of the use of the information presented. The major objective of the system fault isolation procedures contained in chapter 7 shall be described. In addition, this shall contain a brief description of each type of maintenance diagram. A fault directory shall be included which relates fault symptoms found during operation to the fault-isolation procedures. Fault-isolation procedures, fault logic diagrams, control function diagrams, and data function diagrams shall be included as follows:

- a. Operation-based symptom fault directory.
- b. Fault-isolation procedures.
- c. System fault logic and troubleshooting maintenance dependency matrix diagrams.
- d. System control function diagrams.
- e. System data function diagrams.

3.6.8.1 *Operation-based symptom fault directory.* The directory shall relate system faults observed during operation described in chapter 4 to fault isolation diagrams. The directory shall be presented in tabular form by operational modes (see figure 45). The table(s) shall include references to system fault isolation diagrams, and where applicable, directly to equipment troubleshooting diagrams. The content of the table shall include, as applicable, the following information:

- a. *Table headings.* Table headings shall be identified by the operational mode to which the table relates.
- b. *Column headings.* The fault directory shall contain the following columns.

(1) *Column 1, Operating procedure step.* This column shall list the step of the operation procedure in chapter 4 for which a fault symptom can be observed. (For example, if step 1 is an action step (set XYZ switch to ON) with no operational response, step 1 would not appear in the column. However, if step 1 stated "Set XYZ switch to ON and check to see that XYZ lamp lights," then step 1 would be included in the column.)

(2) *Column 2, Functional description.* This column shall include the reference to the paragraph number of the functional description in chapter 5. In addition, when an operation can be identified with an output, this column shall also contain the name or symbol of the output.

(3) *Column 3, Fault isolation procedure.* This column shall reference by paragraph number the fault isolation procedure.

(4) *Column 4, Alignment procedure.* This column shall reference by paragraph number the alignment procedure in chapter 8.

(5) *Column 5, Fault isolation diagram.* This column shall reference the fault isolation diagram by figure and sheet number.

(6) *Column 6, Equipment document.* This column shall reference the equipment technical manual when the fault can be isolated to the specific equipment causing the fault.

3.6.8.2 *Fault isolation procedures.* Procedures shall be included for isolation of a trouble to a single equipment or functional area of an equipment. The procedures shall provide for the analysis of switching combinations and observable indications (dials, gage lamps, and meters). The use of any required test equipment shall be described. The procedures shall support the fault-logic, control-function, and data function diagrams. The supporting diagrams shall be referenced by figure number. Prerequisite control settings and conditions shall precede each procedure.

3.6.8.3 *System fault logic and troubleshooting-maintenance dependency-matrix diagrams.* System fault logic diagrams shall be prepared for fault indications observed during either scheduled tests or operation. Fault logic diagrams shall be constructed in accordance with 3.5.7.2.12.2. These diagrams shall isolate the functional area of the equipment at fault and

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then refer the user to the equipment technical manual containing the information needed to complete the fault isolation and repair. Each diagram shall include or make reference to information necessary to establish the system test or operating conditions required for starting the fault-isolation procedure. The conclusion boxes shall list the equipment or functional area within an equipment that is the probable source of malfunction and the technical manual reference or references for further isolation and repair of the fault. Troubleshooting-matrix diagrams in accordance with 3.5.7.2.12.3 may be substituted for or augment fault logic diagrams.

3.6.8.4 Control function diagrams. Control function diagrams shall be provided for all system control circuits. The control function diagrams shall be at the system level but shall be constructed in accordance with 3.5.7.2.3.3. The diagrams shall show essential fault isolation test points or comparable indicators, and shall include appropriate references to equipment manuals.

3.6.8.5 Data function diagrams. Data function diagrams shall show in detail the system information needed to isolate faults within signal or data flow paths. Data function diagrams shall include tolerance values and shall contain references to equipment publications where necessary. All inputs required to develop the output shall be shown. The data function diagrams shall be constructed in accordance with 3.5.7.2.3.1a, c, d, e, f, i, j, k, l, m, and p.

3.6.9 Chapter 8, Alignment procedures. Chapter 8 shall present the corrective adjustment procedures and support information necessary to restore electrical and mechanical alignment between the various system equipments. Include all values and tolerances. The alignments shall be cross-referenced to respective fault isolation procedures and diagrams in chapter 7. Alignment procedures shall include references to equipment publications where further procedures are required at the equipment level. The alignment procedures shall be presented in step-by-step form.

3.6.10 Chapter 9, Installation data. Installation drawings and information not contained in the equipment technical manuals are neces-

sary to install and checkout the system. System installation data shall include the following:

- a. Summary of all utilities required by the system, such as air, water, power, steam, freon, etc.
- b. System interconnection diagrams.
- c. Cable run diagrams.
- d. System piping diagrams.
- e. System cable interconnection check.
- f. Active system tests.
- g. System component installation procedures.

3.6.10.1 Utilities list. A utilities list shall be included that presents in tabular form all utilities required, and the quantities of each, in each system, compartment, and area.

3.6.10.2 Interconnection diagrams. Interconnection block diagrams shall be presented with each equipment or component shown as a block. All cables running between equipments shall be identified by cable number. The number of active and spare leads in each cable shall be included. The illustrations shall also indicate all junction boxes, switchboards, etc., into which interconnection cables enter or leave.

3.6.10.3 Cable run diagrams. Isometric diagrams shall be used to indicate the location of all cable runs between compartment or areas. Each cable run diagram shall indicate by deck, compartment, and frame identification the location of all cables shown on the interconnecting diagrams.

3.6.10.4 System piping run diagrams. Isometric diagrams shall be used to indicate the location of all system piping runs between compartments and areas. Each piping run diagram shall indicate by deck, compartment, and frame identification the location of all pipes, valves, fittings, tanks, etc.

3.6.10.5 System cable interconnection check. Cold-wire check procedures shall be provided to verify the proper installation of all system cables. These checks shall be prepared to be conducted with all power off and all equipment completely shut down.

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3.6.10.6 Active system tests. All active system test procedures required to verify the proper installation and operation of the system shall be included. Reference may be made to applicable tests and procedures in chapter 6. Procedures for complete setup, testing, shut down, and data analysis shall also be provided.

3.6.10.7 System component installation procedures. Complete step-by-step instructions shall be provided for installation of system components not covered in any of the equipment manuals for the equipment comprising the system. The following types of supplemental information not provided in the equipment technical manual shall be included:

- a. Instructions required to assemble components.
- b. Instructions required to mount components. Include boring and bracing diagrams and data on shock mounts.
- c. Instructions for making electrical, waveguide, plumbing and all other interface connections between equipments, components, and other systems.
- d. Servicing procedures, such as initial lubrication and adjustments.
- e. Instructions for bonding and grounding.

3.6.10.7.1 Installation drawings. The following drawings shall be included:

- a. Pictorial diagrams.
- b. Outline and mounting dimension data.
- c. Interconnecting wiring and cabling diagrams.
- d. Primary power distribution.
- e. Piping diagrams.

3.6.10.8 Installation checkout. Provide step-by-step procedures to demonstrate that the system operates correctly and within tolerances. These procedures shall provide for system checkout in three test phases as follows:

- a. *Phase 1—Installation inspection and pre-energizing procedures.*
- b. *Phase 2—Turn-on and preliminary tests.*
- c. *Phase 3—Installation verification test.*

3.6.10.9 Phase 1—Installation inspection and pre-energizing procedures. Provide inspection procedures in the form of check lists to verify the following:

- a. That the system and required auxiliary equipments have been installed and that their location and orientation is proper; that all cables, antennas, waveguides, transmission lines, dehydrators, coolant lines, piping, etc., have been installed in accordance with plans and specifications; that continuity exists in all interconnections.
- b. That special system test equipment listed in chapter 1 is onboard, operating satisfactorily, and has been calibrated.
- c. That all field changes, mandatory retrofits, or shipalts have been accomplished.
- d. That all rotating devices are free from obstruction.
- e. That there is access to the system components for maintenance.
- f. That all pre-energizing servicing procedures, including lubrication, have been accomplished.
- g. That it is safe to operate the system.

3.6.10.10 Phase 2—Initial turn-on and preliminary test. Include procedures for energizing the system for the first time. This may be accomplished by reference to the applicable portions of chapter 4. Include step-by-step procedures for testing electrical, steam, and fluid supply circuits, distribution panels, breakers, and interlocks. Include procedures for testing piping, cables, transmission lines, and waveguides for proper installation, including checks for hanger spacing, torquing of connectors, pressure testing, standing wave ratio, and attenuation checks.

3.6.10.11 Phase 3—Installation verification test. Include complete instructions for testing the system in all modes of operation. Where applicable, refer to the scheduled performance tests in chapter 6. Procedures shall cover checking gages, meters, alarms, and other sensing devices for proper operation and calibration. Tests shall verify that all inputs are in tolerance. Where applicable, include VSWR and insertion loss tests to verify the proper installation of antenna-to-equipment

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waveguide runs; transducer impedance and source level checks to verify proper installation of transducers, domes, and cables; dynamic and static load tests for hoists, winches, etc. Preliminary setup data shall be included in each procedure. When it is required that an alignment be accomplished prior to performing a test, the alignment shall be included or referenced in the procedure.

3.6.10.11.1 Test procedures. Testing procedures shall be presented in a logical order as follows:

- a. Energize the system.
- b. When test results are within the required tolerance, include a reference to the next logical test. When test results are out of tolerance, include a reference to the corrective maintenance or troubleshooting data. Reference shall be made to troubleshooting diagrams except where probable causes of failure can be predicted, in which case reference may be made directly to an alignment or repair procedure.

3.6.10.11.2 Installation standards summary sheet. The installation standards summary sheet shall provide spaces for recording the results of all installation verification tests. Each space shall be identified by the step or paragraph number which provides the instructions for accomplishment. Each space shall contain the respective unit of measurement (e.g., amp., db., or v.). When applicable, waveforms shall be included to show the points on the pattern where the measurement is to be taken. In addition, critical installation data shall be included, such as length of transmission line.

3.7 Format.

3.7.1 General requirements. Style and format shall conform to MIL-M-38784 and 3.7.2 through 3.7.5.3. Graphic symbols and reference designations for electrical and electronic diagrams shall be in accordance with USAS Y14.15, Y32.2, Y32.14 and Y32.16. Abbreviations shall be in accordance with MIL-STD-12.

3.7.2 Volumes. A single volume manual shall not exceed a three inch thickness. When the thickness exceeds three inches, chapter 2 (types I and II) or chapter 4 (type III) shall

be bound separately. When three or more volumes are required to maintain the three-inch thickness limitation per volume, one or more additional chapters shall be bound separately in the following order:

- a. Installation.
- b. Parts list.
- c. General information.
- d. Scheduled maintenance.
- e. Corrective maintenance.

3.7.3 Distribution statements. The applicable distribution statement shall be included on the cover and title page (see 6.2 and 6.2.1).

3.7.4 References.

3.7.4.1 Referencing between diagrams. Referencing between diagrams shall be by figure number; sheet and zone numbers shall also be included for multisheet and zoned diagrams.

3.7.4.2 Text references. All illustrations shall be referenced in the text. References to illustrations shall be by figure number in accordance with MIL-M-38784. If the figure is located in another volume of the manual, reference shall also be made to the number of the volume. Where multiple sheet figures are referred the sheet number(s) involved, for example: "See figure 3-7, sheet 2."

3.7.4.3 Reference placement. References shall conform to the following:

- a. When a reference applies to one item within a sentence, place the reference parenthetically immediately after the item being referenced, for example: "The test set (figure 1-1) comprises a main panel (figure 1-2) and a power supply (figure 1-3)." When a reference applies to an entire sentence, place the reference at the end of the sentence; for example: "This characteristic causes the first portion of control movement to be less effective (see figure 6-3)." or show the reference in a complete sentence: "The procedure for making the adjustment is shown in figure 6-23."

- b. When a reference applies to an entire paragraph or paragraphs, place the reference after the paragraph head, for example: "6-2 Simulation Diode Monitor (figure 6-56)."

- c. When reference is made to items in fig-

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ures by reference designations, the numbers shall be indicated in the following manner: "The ON-OFF switch (1S8, figure 3-6) on the center console controls the TWT cooling."

3.7.4.4 Paragraph references. For single volume manuals, reference to text matter shall be by paragraph numbers only. For multi-volume manuals, reference shall be by volume number and paragraph number.

3.7.4.5 Zoning on diagrams. Diagrams containing the symbols for more than 100 parts shall be zoned. Diagrams shall be divided into equally spaced horizontal zones (ordinates) designated A, B, etc., from bottom to top along the outside left and right borders. Diagrams shall be divided into equally spaced vertical zones (abscissa) designated 1, 2, 3, etc., from right to left along the outside top and bottom borders. The zone size shall be as needed to clearly locate referenced points. The location of all circuit elements by zones shall be included in a table located on the apron.

3.7.4.6 Reference to zones. In reference to zones, the numeral shall be listed first to avoid possible confusion with reference designations, for example: use "3C" instead of "C3."

3.7.5 Notes for diagrams. Notes on diagrams shall be confined to clear spaces of the image area. Notes for foldout diagrams, with the exception of installation control drawings, shall be placed on the apron. Notes shall be identified with the legends GENERAL NOTES and SPECIFIC NOTES, as applicable. General notes shall precede specific notes and shall be identified by capital letters (A, B, etc.). Specific notes shall be identified by arabic numerals (1, 2, etc.).

3.7.5.1 General notes. General notes shall apply to the entire diagram and shall appear only on the first sheet of multisheet diagrams. No reference shall be made to general notes from the diagram or from specific notes. Examples of general notes are: a warning that high voltage exists throughout the entire equipment, the general instructions for positioning switches, and a list of the test equipment needed to take measurements throughout the diagram.

3.7.5.2 Specific notes. Specific notes shall apply only to a specific item on the diagram.

Specific notes shall be repeated on each sheet of a multiple sheet diagram to which they apply and it shall not be required to refer to a specific note on another sheet of a diagram.

3.7.5.3 Apron notes. Apron notes for foldout diagrams should be placed in a final size image area of 7 by 10 inches with a minimum letter height of 0.060 inch. Notes shall be arranged to make best use of the available space. When notes for a given diagram foldout sheet require more than the 7 by 10 inch apron image area, the notes shall be extended with additional columns onto the diagram image area if the space permits. If space does not permit, single pages shall precede the foldout and shall contain the additional notes. When additional note sheets are required, the notes shall start on the first additional sheet and be printed as a right hand page; note pages may be printed on both sides. Foldout sheets shall not be used for running text. Each sheet of the diagram, including the note sheets, shall contain the figure number, title, and sheet number.

3.8 Production.

3.8.1 Typography. Typography shall be as specified in MIL-M-38784 for double-column bookface type. Letters, lines, and symbols shall be of a uniform contrast throughout the technical manual. Blurred or smudged printing or dropout characters or lines shall be cause for rejection. All manuals shall meet the requirements for good reproduction by 35mm microfilming in accordance with MIL-M-9868/1. Typography for change pages shall conform as nearly as possible to the original manual. Preferred typography is specified in MIL-M-38784.

3.8.2 Illustrations. Illustrations shall conform to MIL-M-38784 and the following:

a. Lettering. Final size lettering shall be a minimum of 0.060 inch.

b. Line artwork. Line artwork shall be prepared with line weights of sufficient strength to reproduce a minimum final line weight (when reduced) of .01 inch. Final size line artwork shall be suitable for reduction to 35mm microfilm in accordance with MIL-M-9868/1.

c. Identification of part symbols and piece

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part symbols. All part symbols and piece part symbols shall be identified by reference designations. In addition, all parts such as switches, controls, indicators, blowers, etc., shall be identified by name. All control panel markings relating to these parts shall have the name printed exactly as shown on the panel and enclosed in a rectangle.

3.8.3 Paper stock for printed manuals. Paper stock for text pages and foldouts shall be in accordance with MIL-P-38790.

3.8.4 Cover and title page stock for printed manuals. Unless otherwise specified in the contract or order, covers of manuals shall be printed on cover stock JCP R10 (891 pound type) in accordance with MIL-P-38790. Information to be imprinted on the covers shall not be stamped in gold or other metal foil. Colors for covers are as follows:

Unclassified	Blue
Confidential	Green
Secret	Yellow
Top Secret	Pink

Title pages shall be printed on JCP A-60 (100 pound type) white paper.

3.8.5 Binding. Binding of manuals shall be in accordance with MIL-P-38790. Manuals shall be prepared in loose-leaf form to facilitate the insertion of replacement pages. Unless otherwise specified in the contract or order, corrosion-resistant posts and screws or snap-ring metal prong fasteners shall be used. All metal parts shall be treated to resist corrosion. Manuals shall be punched or drilled in accordance with MIL-P-38790. Page sizes and punching or drilling for change pages shall be the same as for the original manual. Fillers shall be used to build up the binding edge to the same thickness as the right-hand edge of the manual.

3.8.6 Preliminary manuals (types I, II, III), service test equipment manuals (type IIS), and experimental equipment manuals (type IIX).

3.8.6.1 Typography. Except when it is more economical to the Government to supply a higher quality of typography, preliminary, type IIS, and IIX manuals shall be typewritten (single-spaced). The copy shall be such that clear, readable reproductions may be ob-

tained. Any method of duplication, as defined in NAVEXOS P-35, which will provide the necessary quantity of black and white legible copies will be acceptable. When the method of duplication permits, the manual shall be produced on both sides of the paper.

3.8.6.2 Layout. Layout shall conform to the requirements for final manuals except that horizontal folds are acceptable on foldout pages.

3.8.6.3 Illustrations. Illustrations should be prepared by the most economical method which will result in clear, legible illustrations when produced.

3.8.6.4 Paper and cover stock. Paper stock which is suitable for the intended use will be satisfactory for text and foldout pages. Cover stock satisfactory for the intended use is acceptable; however, the color shall conform to the requirements for final manuals (see 3.8.4).

3.8.6.5 Binding. Binding shall conform to the requirements for final manuals (see 3.8.5). Covers need not include any printed matter (other than the security classification) if suitable cut-out windows and back-up pages with identifying data are provided.

3.9 Applicability of manuals.

3.9.1 Identical manuals (types I and III). When a manual that is already available is applicable in its entirety to the equipment or system being procured, the applicability is to be extended to additional ships. However, the contractor shall issue a new approval and procurement record page (see 3.4.2.1.4).

3.9.2 Manual modifications. When an existing manual is applicable to an equipment being procured, except for minor differences, the contractor shall modify the manual to cover the differences by the issue of a permanent change or revision, as applicable, in accordance with 3.10.

3.10 Changes and revisions. The changes and revisions shall correct all inaccuracies or omissions determined during usage or contractor generated design or production changes to the equipment or system, until expiration of the contractor's responsibility for the last equipment or system delivered.

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3.10.1 Responsibility for changes or revisions to final manual. Contractors shall be responsible for issuing necessary corrections and changes to technical manuals throughout the life of the contract and guarantee period. The contractor shall supply either changes or revisions.

3.10.1.1 Changes. Changes to an existing manual shall be issued in the form of replacement pages as specified in MIL-M-38784. Upon application, change numbers (NAVSHIPS or NAVELEX numbers) will be assigned by the command or agency concerned (see 3.10.2 and 3.10.3).

3.10.1.2 Method. A change shall consist of revised pages and detailed instructions (instruction sheet) for inserting the pages into the manual. When the equipment nomenclature has been changed because of a production or field change to the equipment, the nomenclature references in the text and illustrations need not be modified merely to include the new nomenclature, providing that information equivalent to the following is included in the introduction of chapter 1: "All references in the manual to Radar Set AN/SPS-40 apply equally to Radar Set AN/SPS-40A, unless otherwise indicated." If an equipment change does not affect the entire equipment population, the change shall be prepared in such a manner that the manual will describe both the affected and the unaffected equipment. If the change applies to the entire equipment population, the change shall cover only the modified equipment and a note shall be included in the first paragraph of the instruction sheet to the effect that maintenance support activities should not dispose of the superseded pages until it can be established that all of the equipment population has been modified. Equipment holders should be instructed to update their publication when the modification has been accomplished.

3.10.1.3 Instruction sheets. A change shall include an instruction sheet (see figure 47), which provides instructions for inserting new and revised pages and disposing of superseded pages (see 3.10.2).

3.10.1.4 Issue information. Changed pages shall include the change number; backup

pages not affected by the change shall include the existing issue information.

3.10.1.5 Production of changes. Changes shall be prepared in the same style, format, and specifications as the basic manual. Changes shall be inserted (by the contractor) into the manuals that are shipped with the equipment, after the changes are available.

3.10.2 Interim (temporary) changes. Information to amend, correct, or modify manuals may be supplied as an interim (temporary) change, when major changes are necessary and there is insufficient time available to publish a permanent change prior to the need or as specified in the contract or order. Interim changes are subject to replacement by a permanent change. An interim change shall be identified and dated; shall contain an instruction sheet (see 3.10.1.2 and figure 47). The instruction sheet shall include the following, as applicable:

a. The publication number shall appear in the upper left hand corner of each page. The interim change shall be identified with a "T" identification number (assigned by the procuring activity) and the publication number to which it applies, for example, T4-NAVSHIPS 0967-0000-1234 would designate the fourth interim change to NAVSHIPS 0967-0000-1230.

b. The total number of pages shall be indicated on the first page only.

c. The security classification shall be located on all pages of all classified interim changes and shall appear at the top and bottom center. The word "UNCLASSIFIED" shall appear on top and bottom center of the page when unclassified.

d. A statement shall be included indicating when the interim change is in effect. If it supersedes an earlier interim change or a permanent change a statement of that fact should be given.

e. If an equipment change is involved (field or production change), a statement shall be included indicating the purpose of the change and the extent (serial numbers or conditions of application) to which it applies to the equipment population.

f. A list of revised pages (if any) issued as

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part of an interim change shall be included with instructions for inserting the new or revised pages for disposition of superseded material, and for correcting the title page and list of effective pages (see figure 46).

g. Instructions shall be terse and clear; illustrations and diagrams corrected, as applicable; and specific data to be changed shall be set off in quotation marks.

h. The instructions shall be followed by a statement that the interim change shall be inserted in the manual immediately under the front cover.

i. Printed matter shall be arranged on the page so that all copy is readable when bound in the manual.

j. Quantity and distribution shall be in accordance with 3.12.2.

3.10.3 Permanent changes. A permanent change shall include all corrections issued in previous interim changes (unless they have been covered in a previous permanent change) and in addition to all equipment changes required by the contract or order. The permanent change shall include an instruction sheet (see figure 47) prepared with the same requirements as for interim changes that includes step-by-step procedures for inserting the change into the manual. Change numbers shall be requested from the procuring activity when the manuscript is submitted for approval. It shall also include the following:

a. A new cover and binding fasteners (for each volume affected) if the change includes too many pages to fit in the original cover.

b. A revised title page including the original approval date of the publication and the approval date of the change. The NAVSHIPS or NAVELEX number for the change shall be inserted below the change number and date. The basic publication number appearing in

the upper left-hand corner shall remain unchanged.

c. A revised list of effective pages (see figure 46).

d. Revised pages, table of contents, list of illustrations, list of tables, index, and content assurance pages, as applicable.

e. If a publication consists of more than one volume, changes shall be prepared separately for each volume but shall be assigned the same change number.

f. Parts lists may be corrected by means of supplementary parts lists which precede the parts list section (rather than by revising each applicable page) provided the supplementary lists do not exceed one-fifth the size of the main parts list. In subsequent changes, the supplementary list may be revised until it exceeds one-fifth the size of the main list. Should this percentage be exceeded, the parts list section shall be completely revised.

3.10.4 Revisions. A revision is a second or subsequent edition of a manual or volume of a manual which supersedes the preceding edition. A revision shall be supplied when the number of pages required to supply corrected and additional information for the manual is more than 25 percent of the total pages of the manual. When a revision is issued the following supersedure notice shall be included on the title page: "This publication supersedes NAVSHIPS or NAVELEX (number) date (day, month, year)." Revisions shall conform to the contract requirements, MIL-M-38784, and this specification (see 3.4.1.5 and 6.5.13.).

3.11 Approval and acceptance. All publications prepared by or for the Naval Ship Systems Command and Naval Electronic Systems Command shall be approved by the respective command, its field activities, or its representatives. Contractually deliverable items listed in 3.13 shall be submitted for approval in sufficient time (or as scheduled in the contract) to allow for an adequate review by the Government. Approved deliverable items will not be accepted by the Government until the contractor has complied with all conditions of approval.

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3.11.1 Publication or change number. The contractor shall request a publication or change number from the Government approving activity when the review manuscript is submitted for approval.

3.11.2 Preliminary manuals.

3.11.2.1 Preliminary (review) manuals (type I). Type I preliminary (review) manuals are required to be submitted for approval by the Naval Ship Systems Command or its field representatives before the final manuals are printed and distributed. If the final manuals are not available at the time the equipment is shipped, preliminary manuals, as approved, shall be shipped with the equipment to be used with the equipment until the final manuals are available (see 3.12.1).

3.11.2.2 Preliminary manuals (type II). When there is insufficient time (less than approximately six months) to permit approval by the command or agency concerned and still provide for the preparation and printing of final manuals to be shipped with the first equipment delivered, preliminary manuals shall be supplied with the equipment at no additional cost to the Government. Permission shall be obtained from the procuring activity for shipping the preliminary manual when any required data is missing. A review copy of the preliminary manual shall be submitted to the cognizant Government inspector for approval. Supplying preliminary manuals does not relieve the contractor from any contractual requirements pertaining to delivery of complete, adequate, and accurate final manuals.

3.11.2.3 Preliminary manuals, review copy of (type II). The preliminary manual review copy shall be submitted (prior to shipment of the first equipment) to the Government inspector simultaneously with four copies of the manual to the command or agency concerned. Publications numbers for preliminary manuals shall be requested from the approving activity. After authorization and the publication numbers are received, two copies of the preliminary manuals shall be packaged with each equipment.

3.11.2.4 Self-addressed post card. A self-addressed contractor-furnished post card containing information equivalent to the notice indicated below shall be attached to the title page of all preliminary manuals which accompany the equipment.

"IMPORTANT NOTICE: This is a preliminary manual for (insert nomenclature of equipment), publications (insert number). A copy of the FINAL manual

will be forwarded direct to you when printed. Return this card IMMEDIATELY, indicating ship or shore activity and mailing address."

Copies of final manuals shall be forwarded by the contractor to activities that submit post cards before shipment of the final manuals to stock. When post cards are received by the contractor after shipment of the bulk stock quantity of manuals has been made, the cards shall be forwarded to the cognizant Government inspector with a request to forward the cards to the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

3.11.3 Manuscript—basic manual, changes, or revisions. Five review manuscript copies of the basic manual, changes, or revisions shall be submitted to the Government approving activity for approval and assignment of a publication number (see 3.13.4 and 5.1.4). Unless otherwise specified in the contract or order, a minimum of six weeks shall be allowed for Government approval.

3.11.3.1 Certification check-off list (types II, IIS, IIX, and III). A signed and completed certification check-off list for types II, IIS, and IIX manuals shall be prepared in accordance with figure 48 for preliminary, final manuals, and revisions. It shall be submitted to the procuring activity with the review copies and shall indicate the degree to which the manuscript conforms with this specification. A similar list shall be prepared for changes and type III manuals. The certification check-off list prepared for permanent changes of Government furnished manuals shall certify the extent to which the content requirements conform to this specification.

3.12 Quantity and distribution. The quantity of manuals shall be as specified in the contract or order (see 6.2). The contractor shall be responsible for the distribution of all manuals procured on the contract or order. Unless otherwise specified, two copies of preliminary or final manuals shall be shipped with each equipment. Bulk quantities shall be distributed at time of shipment of first equipment, except that when preliminary manuals are supplied in accordance with 3.11.2, quantity and distribution shall be as specified in 3.12.1, and the final manuals shall

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be distributed within 90 days after receipt of approval.

3.12.1 Preliminary manuals. Unless otherwise specified in the contract or order, the quantity shall be two per equipment. For type II manuals, a bulk quantity up to the bulk required for final manuals, but no less than 25 copies shall be supplied. (The total quantity of preliminary manuals to be supplied will depend upon the need at the time and the expected delay in production of final manuals. Distribution will be as directed.) Distribution of bulk quantities shall not be later than 30 days after the shipment of the first equipment.

3.12.2 Changes and revisions. The quantity of changes and revisions shall be as specified in the contract or order, or ship's specifications. The distribution of such material shall be to all activities receiving the original manual and in the same quantity or as directed by the command or agency concerned.

3.13 Deliverable items. As specified in the contract or order (see 6.2), deliverable items shall include the following:

- a. Book plan (types II, IIS, IIX, and III).
- b. Quality program.
- c. Preliminary manual (review) (type I).
- d. Manuscript (review) (types II, IIS, IIX, and III).
- e. Preliminary manual (types II, IIS, IIX and III).
- f. Reproducible copy.
- g. Replenishment material.
- h. Printed manuals.
- i. Status reports (monthly).
- j. Photolithographic negatives.

3.13.1 Book plan (types II, IIS, IIX and III). A book plan shall be based on a plan for maintenance of the equipment and shall be submitted to the procuring activity for review and acceptance prior to development of the review manuscript. The manual outline shall conform to MIL-V-38784 and the following:

- a. A text outline, including front matter, prepared in accordance with the content requirements

of this specification, to the level of paragraphing necessary to show the major physical and functional aspects of planned coverage. Each chapter and paragraph title or notation listed shall be followed by a short statement outlining the data to be presented. Describe the planned approach and logic of troubleshooting principles and the troubleshooting data presented and how they relate with the description to be presented in the manual. Each illustration applicable to a particular text statement shall be referenced by the figure number and title following the statement. An index in tabular form, listing each illustration, table by number, and title shall be included. Describe each illustration by type (exploded view, schematic, line drawing, etc.), information content, and approximate size. All nomenclature shall be consistent between text and illustrations.

- b. A sample of each applicable type of drawing prepared in accordance with this specification, shall be part of the book plan.

- c. A summary of the major points of the quality program requirements in accordance with 4.2.

d. When MIL-M-24365 is invoked in the contract, the outline of the content requirements shall be based on a plan for use as supplied by the Government, and a maintenance engineering analysis (see 3.5.6.5.1) of the equipment. The outline shall indicate coverage on a comprehensive and systematic basis the most effective and efficient method of performing necessary maintenance. The outline shall be correlated to the maintenance engineering analysis reports by direct referencing.

3.13.2 Quality program. A quality program in conformance with 4.2 shall be maintained.

3.13.3 Preliminary (review) manual (type I). A preliminary (review) manual (type I) shall be submitted to the procuring activity for review and approval prior to the preparation of reproducible copy and printing of final manuals. The preliminary manual shall have all text and illustrations included necessary for installation, operation, maintenance of the equipment, and suitable for engineering review. The text may be typewritten and the illustrations shall be legible. The production method may be by the most economical method at the option of the contractor.

3.13.4 Manuscript review (types II, IIS, IIX, and III). Five copies of the review manuscript shall be submitted to the procuring activity for review and approval prior to the preparation of reproducible copy (see 3.11.3 and 5.1.4). Review manu-

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script shall be submitted within 60 calendar days after delivery of the first article sample but not later than six months prior to delivery of the first equipment, in sufficient time to allow for preparation of reproducible copy and printed manuals. Review manuscript shall conform to MIL-M-38784 and the following requirements:

a. The text shall be presented on one side of the paper and shall contain the exact wording and content intended for the reproducible copy. The production method may be by the most economical method at the option of the contractor.

b. Reproduction of pencilled illustrations are acceptable, if their technical content, clarity, correctness, and adequacy meet specification requirements. Illustrations submitted for review purposes shall be legible and shall not exceed the reproducible copy size. All illustrations shall be bound separately.

3.13.5 Preliminary manual (types II, IIS, IIX, and III). Unless preliminary manuals are required as deliverable items by the contract or order, preliminary manuals should be supplied in accordance with 3.11.2.2.

3.13.6 Reproducible copy. Final reproducible copy, including original artwork, complete in all respects for photographic reproduction, shall be prepared in accordance with MIL-M-38784 and shall be delivered as directed.

3.13.7 Photolithographic negatives. Photolithographic negatives shall conform to the requirements of MIL-P-38790.

3.13.8 Printing and binding. Printing and binding shall be in accordance with MIL-P-38790.

3.13.9 Replenishment material. The replenishment material consisting of one copy of the final manual with the set of photolithographic negatives used to produce the manual shall be forwarded as directed by the procuring activity. This material when forwarded shall have a covering letter advising that the material is for replenishment purposes (see 6.5.12).

3.13.10 Status reports. The contractor shall prepare and deliver to the procuring activity a report each month beginning 30 days after award of contract through validation until final approval of the manual has been ob-

tained. The report shall indicate the degree of progress, problems encountered, and any delays that may effect production of deliverable items.

3.14 Rejection criteria. Failure of contractors to meet all contractual requirements, including this and other referenced specifications, shall be cause for rejection and subject to correction. The following requirements shall also apply to rejection criteria:

a. **Book plan.** Unless permission is obtained from the procuring activity, failure to conform with the approved book plan (see 3.13.1).

b. **Technical accuracy and inconsistencies.** Failure of all information to exactly represent the equipment or system being described and to be consistent with descriptive terms.

c. **Omission of data.** Omission of any applicable data elements required by this specification.

d. **Validation.** Failure to provide adequate evidence of validation.

e. **Workmanship.** Failure to conform with the requirements of 3.8 and MIL-M-38784.

f. **Reproducible copy and photolithographic negatives.** Failure to include changes or corrections required as conditions of approval.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier (see 6.5.17) is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Quality program requirements. The supplier shall document and maintain a written quality program (see 6.3) to the extent required to assure that the manual accurately and adequately reflects the equipment or sys-

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tem involved; includes the necessary installation, operation, maintenance, repair, and parts support procedures necessary for satisfactory performance. Acceptance of the program (see 4.3) shall be obtained from the procuring activity or its designated representative prior to development of any part of the manuscript (types II, IIS, IIX, or III) or the preliminary (review) manual (type I). The program shall assure the comprehensive control of the development and evaluation of the manual(s).

4.2.1 Quality program (general). The quality program shall be in accordance with the following:

a. Organization. Effective management for quality shall be clearly prescribed by the supplier. Personnel performing quality functions shall have well defined responsibility and authority and the organizational freedom to identify problems and to initiate, recommend and provide solutions. Management shall review the status and adequacy of the program on a regularly scheduled basis.

b. Initial quality planning. The supplier, during the earliest practical phase of contract performance, shall conduct a complete review of the contract requirements to identify and make timely provision for any special controls, processes, tests, skills, which may be required. This initial planning shall include the development, maintenance, and implementation of methods and procedures to assure the quality of the manual. This planning shall provide for appropriate review and actions to assure compatibility of preparation, inspection, validation, and documentation.

c. Manual (preliminary or manuscript) inspection and validation. The quality program shall assure that there is a system for inspection, validation (see 6.5.20), and correction of manuals, in parallel with the design and manufacture of the equipment or system. Validation shall provide a measure of the overall quality of the manual and shall be performed in accordance with 4.2.2(d). When revisions or corrections are required, after any inspection, validation, or approval, there shall be reinspection, revalidation, or reapproval of any characteristic affected.

d. Subcontracting. Not required if subcontractor does not prepare, inspect or validate manuals.

(1) Responsibilities. The supplier shall be responsible for assuring that all manuals procured from his subcontractors conform to the contract and specification requirements. The extent of control invoked and exercised by the supplier shall be identified in the quality program. To assure adequate and economical control, the supplier shall utilize objective quality evidence (see 6.5.7) furnished by his subcontractors. When the Government performs an inspection(s) at a subcontractor's plant, such inspection(s) shall not be used by the supplier as evidence of effective control of quality by such subcontractors. The effectiveness of subcontractor quality control shall be reviewed by the supplier at regular intervals. The supplier shall inspect manuals upon receipt from the subcontractor to assure conformance with requirements. All deficiencies shall be promptly corrected by the supplier.

(2) Purchase orders. The supplier's quality program shall not be deemed acceptable to the Government unless the supplier requires of his subcontractor a quality effort achieving control of the quality of the manual(s). The supplier shall assure that all applicable requirements are properly included or referenced in all purchase orders. The purchase order shall contain a complete description of the manuals and material ordered including, by statement or reference, all applicable requirements for preparation, inspecting, validating, packaging, packing and any requirements for Government or supplier inspections, certifications or approvals. The description of manuals shall include a requirement for supplier inspection at the subcontractor's, when necessary to assure that his quality program effectively implements his responsibility for quality assurance. The purchase order shall contain a requirement for subcontractors to notify and obtain approval from the supplier for unauthorized changes in design or content of the manual. Instructions shall be provided when direct shipment from the subcontractor to Government activities is authorized.

(3) Government inspection, verifica-

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tion, approval of preliminary manuals (type I), or manuscripts (types II, IIS, IIX, or III) at subcontractor facilities. Government inspection, verification (see 6.5.21), approval of type I preliminary manuals, or review manuscripts shall not constitute acceptance; nor shall it in any way replace supplier inspection or validation; or otherwise relieve the supplier of his responsibility to furnish an acceptable manual. When the Government requires inspection or verification at the subcontractor location, the supplier shall include in the purchasing document the following statement:

"Government inspection/verification is required prior to shipment from your plant. Upon receipt of this order, promptly notify and provide a copy of this order to the Government representative servicing your plant so that planning for Government inspection/verification can be accomplished. In the event the Government representative cannot be identified, the prime contractor shall be notified immediately."

The supplier shall report to his Government representative any nonconformances of Government source inspected/verified manuals and shall require the subcontractor to coordinate corrective action with his Government representative.

4.2.2 Quality program (specifics). The quality program shall include, but not be limited to, the following:

a. Designation of authority, functions and duties of those personnel responsible for preparation, inspection and validation of manuals.

b. Coordination with equipment or system design and production activities to assure the use of the latest technical data and information (e.g., operating and maintenance procedures, drawings, illustrations, etc.) for the preparation of the manual(s) and that approved changes to the equipment or system are promptly incorporated in the manual(s).

c. Establishment of in-process inspection points and development, maintenance and implementation of inspection criteria to control the adequacy and accuracy during the development stages of the manual(s).

d. Validation (see 6.5.20) by comparison or performance of the manual content against or on the physical equipment or system that is described by the manual. Performance of the instructions or procedures within the manual shall be accomplished by supplier or subcontractor personnel of the level for which the manual is written using equipment normally available at the installation site; on the ship; or otherwise.

(1) The demonstration by actual performance of instructions and procedures in each manual relating to operation, assembly, disassembly, maintenance troubleshooting, installation, etc., shall be performed by the supplier or his subcontractor at the equipment or ship construction site, or a combination thereof, to the extent technically practical. Checks may be conducted concurrently with normal assembly, test, and disassembly inspections, when applicable. Written information and drawings in each manual shall be compared against actual equipment to ensure that the information and drawings match the actual equipment in all details. Installation drawings and engineering drawings that have been reproduced for use in the manual and have been validated in accordance with MIL-D-1000/2, do not require further validation. Where appropriate, descriptive material may be checked against validated drawings.

(2) All procedures and instructions, except those which will damage the item or incur extraordinary costs shall be demonstrated by review of performance. Procedures that would damage the item shall be demonstrated by review of drawings. Examples are:

(a) Destruction of material, such as disassembly of electronic components or removal of boiler tubes.

(b) Boring, grinding, and other shaping repair procedures.

(c) Removal of distilling plant tube nets, shafting, crankshafts, inner tubes from periscopes, or other parts when accessibility can be determined by measurement, observation, and reference to drawings.

(d) Emergency or damage control operating procedures which would endanger material or personnel.

(e) Operating procedures which would entail excessive costs not encountered

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in the normal operation of the ship. (Excessive costs can be defined to include the provision of special equipment, aircraft, submarine, naval ships, etc., for testing, unless furnished by the Government.)

e. Detailed review of camera ready copy/photolithographic negatives, as applicable, for printing of the manual by the Government, to ensure that they are identical to the approved, validated, verified, corrected, and approved manuscript, and have complied with the legibility and reproducibility requirements.

f. Inspection of the final Government printed manuals (upon receipt from the Government) to insure the proper count, that no damage exists, and through the use of an acceptable sampling plan as a minimum, that the printed manuals represent the camera ready copy or photolithographic negatives, as applicable. (NOTE: Printing by the Government shall not relieve the supplier from providing adequate and accurate content in the manual(s).)

4.2.3 *Identical and modified manuals and changes.* When 3.9.1, 3.9.2 or 3.10.1 applies, the quality program requirements are required to insure that the modifications, changes, and revisions, reflect the equipment as supplied.

4.3 *Quality program acceptance.* Acceptance of the supplier's quality program by the Government in no way relieves the supplier of the final responsibility to furnish manuals as specified. Acceptance shall not preclude additions, refinements, or changes by the supplier, to the quality program where evidence indicates that the program is not or will not meet the requirements of the contract or this specification. When additions, refinements, or changes to the program are determined necessary by the supplier, acceptance shall be obtained from the cognizant Government activity prior to implementation.

4.4 *Content assurance page.* This page in its completed form shall appear in each manual, including manuscripts and preliminary manuals (see 3.4.2.1.5 and figure 2). In separate correspondence, the supplier shall provide justification for any chapter, section, and paragraph not validated. (Insufficient time or

personnel is not considered adequate justification.)

4.5 *Inspection of preparation for delivery.* The packaging, packing, and marking shall be inspected for compliance with section 5 of this document.

5. PREPARATION FOR DELIVERY

5.1 *Packaging and packing.*

5.1.1 *Individual and multivolume technical manuals.* Individual copies and multivolume technical manuals shall be packed to preclude the possibility of damage in transit. Multivolume technical manuals shall be furnished as complete sets except for manuals shipped for stock. Stock copies of identical volumes shall be packed and shipped in common containers.

5.1.2 *Technical manuals shipped with equipment.* When copies of the technical manual are packed with the equipment, they shall be packed within the shipping container holding the main unit of equipment. The shipping container shall be marked with the words "Technical Manuals Inside." The manuals shall be so placed that they are readily accessible prior to removing the equipment, and shall not be placed within the vapor-proof barrier material used to enclose the equipment. Technical manuals which accompany equipment shipments that are packed level A or B shall be transparent packaged in accordance with method IC of MIL-P-116. Technical manuals accompanying shipments that are packed level C shall be packaged in a sealed transparent plastic bag. The invoice, packing list, or bill of lading shall indicate the publication number and quantity of the manuals and shall indicate which container includes the manual and its approximate location therein.

5.1.3 *Bulk shipment.* Technical manuals when shipped for stock in bulk quantities shall not be individually wrapped (see 5.1.1). Containers shall comply with the Uniform Freight Classification Rules or their carrier regulations, as applicable to the mode of transportation.

5.1.4 *Manuscripts for review.* Manuscript copy shall be packaged in accordance with MIL-M-38784 (see 1.3, 3.11.3, and 3.13.4.)

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5.1.5 Reproducible copy and artwork. Reproducible copy and original artwork shall be packaged in accordance with MIL-M-38784. Large size inked-linen or vellum illustrations may be rolled and packed in mailing tubes.

5.1.6 Photolithographic negatives. Negatives for delivery to the printer shall be packaged in accordance with MIL-P-38790.

5.1.7 Replenishment materials. Unless otherwise specified in the contract or order, the contractor shall be responsible for obtaining one copy of the final manual and the photolithographic negatives (used for printing the manual) from the printer and packaging them in accordance with MIL-P-38790. Packages shall be forwarded to the procuring activity or as otherwise directed within 30 days after printing.

5.2 Marking. Bulk quantity shipments, interior packages, and exterior shipping containers shall be marked with the following information for each item enclosed, except for shipment of an individual copy or an individual set of manuals:

Box (number) of (number) (to be listed on multiple container shipments).

Publication number.

Quantity (in package).

Contract or order number.

When applicable, the words "FOR STOCK" shall be marked on the package or packages destined for stock. The publication numbers shall be indicated on the shipping documents. When a contract or order requires technical manuals, revisions, or changes having different publication numbers, the stock copies of each number shall be packaged as separate items. All shipments shall be made in accordance with security requirements (see 3.2).

6. NOTES

6.1 Intended use. The technical manuals prepared to this specification are intended to be used for installation, operation, maintenance, repair and parts support of equipments and systems for the Naval Ship Systems Command and the Naval Electronic Systems Command. It is also expected that the technical manual may be used in whole or in part as a training document.

6.1.1 Type I. Type I manuals are normally required for electrical and mechanical equipment.

6.1.2 Type II, IIS, and IIX. Type II manuals are required for electronic and interior communications equipment; type IIS required for service test electronics and interior communications equipment; and type IIX for experimental electronic and interior communications equipment manuals. However, types II, IIS, and IIX manuals may be specified for electrical and mechanical equipment if the electrical/electronic circuitry and other considerations justify its use.

6.1.3 Type III. Type III manuals are required for systems.

6.2 Ordering data. Procurement documents (including the Contract Data Requirements List, Form DD 1423) should specify the following:

a. Title, number, and date of this specification.

b. Type of manual required (see 1.2).

c. Deliverable data items (see 1.3):

(1) Type I manuals normally require only the procurement of a preliminary (review) manual (see 3.11.2.1) and final manuals.

d. Original manual, permanent change² (see 3.10.3), interim change (see 3.10.2), revision² (see 3.4.1.5, 3.10, and 3.10.4), supplement manual (see 3.4.1.4 and 3.4.3.4).

e. Requirements for appendixes, as applicable (see 3.4.4).

f. Requirements for installation data (see 3.5.10).

g. Applicable distribution statement (see 3.7.3 and 6.2.1).

h. Quantity of manuals required (see 3.12).

² Where the extent of change to the manual is less than 25 percent, a permanent change should be procured. When the extent of a change is over 25 percent, an updated revision (see 3.4.1.5.1) of the manual shall be procured. When the basic manual has been changed to the extent that it is wholly inadequate because of its arrangement, or other reason detrimental to the user, a complete revision (see 3.4.1.5.2) of the manual shall be procured.

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i. Quantity and delivery date of deliverable items (see 3.13).

j. Type of binder.

6.2.1 Distribution statement. A statement used in marking a technical document to denote the conditions of its availability for distribution, release, or disclosure. This statement will be provided by the approving activity (see 6.2).

6.3 Quality program. A comprehensive quality program is necessary to assure adequate and accurate manuals for Navy use. Therefore, the quality program shall cover planning, development, production, inspection, review, validation, and implementation.

6.4 Planning, inspections, and reviews.

6.4.1 Planning. Planning for manuals to support an equipment or system must begin during the early design phase of the related equipment or system, to assure the quality of the manual.

6.4.2 Inspections. In-process inspections conducted by the Government are held primarily to provide guidance to the supplier and to assure that manuals are being prepared in accordance with the contract and specification requirements. These inspections may be conducted at the supplier's facility or his source facility at any time during the development of the manuals.

6.4.3 Review. Verification of manuals may be simultaneously performed with validation in cases where:

a. Time and equipment or facility availability does not permit separate verification.

b. When advantageous to the Government.

6.5 Definitions.

6.5.1 Component. A composite fabricated unit, generally complete within itself, that is designed to perform a stated service when installed in its proper position within a ship or station (e.g., boiler, winch, etc.).

6.5.1.1 Component identification number. Component identification number (CID) is a design identifier which gives the manufac-

turer's name and the characteristics for a particular piece of equipment.

6.5.2 Equipment. One or more assemblies capable of performing a complete function.

6.5.3 Final manual. A final manual complies with all requirements, including production requirements of this specification and has been validated, verified, and approved to be complete and accurate.

6.5.4 Function. A group of circuits or other devices which operate together to accomplish a portion of an equipment or system objective (e.g., transmit, receive, display, hoist, control, etc.).

6.5.5 Interim change. An expeditious method of promulgating a minor manual change by means of addendum sheets and corrections. (Interim changes are often referred to as temporary changes.)

6.5.6 Interior communications equipment. Equipment normally used for shipboard interior communication. These include navigation or related equipment designated Interior Communications (IC) equipment such as the following:

a. Plotting tables.

b. Deck reckoning indicators.

c. Gyros and gyro amplifiers.

6.5.7 Objective quality evidence. (See MIL-STD-109.) Examples of verifiable evidence are validation reports, inspection records, certificates, and any other evidence relating to the control of quality.

6.5.8 Part. One piece, or two or more pieces joined together, which are not normally subject to disassembly without destruction.

6.5.9 Planned maintenance system. Aspects of the Navy's maintenance and material management system as described in Maintenance and Material Management (3-M) Manual OP 43 P2 (0420-049-0060).

6.5.10 Preliminary manuals.

6.5.10.1 Preliminary manuals (type I). A preliminary (review) manual is submitted to the procuring activity for review and acceptance prior to the development of the final manual. The preliminary (review) manual serves the same purpose for a type I manual as a

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review manuscript does for a type II or type III manual. Preliminary manuals shall be superseded by final manuals. Preliminary (review) manuals may be packed with the hardware if the final manual has not been completed.

6.5.10.2 Preliminary manual (types II, IIS, IIX, and III). A preliminary manual is a manual which includes all data required for the final manual but has not received final approval and may not comply with the production requirements for a final manual. Preliminary manuals shall be superseded by final manuals.

6.5.11 Repair. Action required to restore a repairable part, subassembly or assembly to a specified condition, but not necessarily to make like new in physical appearance.

6.5.12 Replenishment material. Replenishment material is material required to provide for economical quality reprinting of technical manuals.

6.5.13 Revision. A second or subsequent edition of a manual which supersedes the preceding edition (see 3.4.1.5). An updated revision is required when the current manual does not accurately or adequately cover the equipment (because of errors, production changes, or field changes made to the equipment) and when the extent of required page changes to the technical manual exceeds 25 percent. A complete revision is required when the basic manual is wholly inadequate because of obsolescence, gross inaccuracies, etc.

6.5.14 Service test equipment. An equipment used for test under service condition for evaluation of suitability and performance. It closely approximates the final design, has the required form, and employs approved parts or their interchangeable equivalents.

6.5.15 Set. A unit or units and necessary assemblies, subassemblies, and basic parts connected or associated together to perform an operational function. Refer to USAS Y32.16 for a detailed description.

6.5.16 Supplement manual (complementary manual). Augments a technical manual so that both manuals jointly represent the con-

figuration of the equipment and all necessary information to install, operate, maintain and repair a basic equipment.

6.5.17 Supplier. This is the same as "contractor" and "prime contractor."

6.5.18 System. A system includes two or more equipments (sets) or components each having its own identity and nomenclature, arranged and interconnected to perform a specific operation.

a. An electronic system can be identified as an IFF system, ECM system, AEW system, ASW system, NTDS system, etc.

b. An electromechanical system can be identified as a propulsion system, underway replenishment system, degaussing system, etc.

6.5.19 Unit. A major building block for a set or system, consisting of a collection of basic parts, subassemblies, and assemblies packaged together as a physically independent entity.

6.5.20 Validation. The process by which the contractor assures the technical accuracy, adequacy, and that the manual represents the latest configuration of the equipment by actual test against the hardware.

6.5.21 Verification. The process by which the Government assures the accuracy of the manual(s) by actual comparison with hardware. This includes Government action to assure proper execution of validation by the contractor.

6.6 Cross-reference of classifications. The following is a cross-reference between the types in this specification (see 1.2) and the types in MIL-M-15071F(SHIPS), dated 28 August 1967:

<u>This specification</u>	<u>MIL-M-15071F(SHIPS)</u>
Type I	Type I
Types II and IIS	Type II
Type IIX	Type IIa
Type III	Type III

Review activities:	Preparing activity:
Navy—EC, SH	Navy—SH
	(Project TMSS-N022)

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APPROVAL AND PROCUREMENT RECORD PAGE			
APPROVAL DATA FOR: NAVSHIPS _____ TITLE OF MANUAL: _____		DATE: _____	
APPROVAL AUTHORITY: _____		CERTIFICATION: _____	
Remarks space shall be used for necessary comments and the inclusion of information regarding the extension of a manual by minor revisions.	Certification: One of the following certification paragraphs shall be typed in this space, as appropriate:	For manuals being furnished for the first time.	It is hereby certified that NAVSHIPS _____ to be provided under contract number _____ has been approved by the approval data shown above.
For identical manuals.		It is hereby certified that the manuals to be provided under contract number _____ are exactly identical to NAVSHIPS _____ approved by authority of approval data shown above.	
For manuals which have been previously distributed but required minor modification.		It is hereby certified that the manuals to be provided under contract number _____ are exactly identical to NAVSHIPS _____ approved by the approval data shown above except for the necessary modification as shown in the above remarks space.	

Approval Authority shall include the applicable letters or correspondence granting approval in conformance with approval procedures.

Approval Authority shall include the applicable letters or correspondence granting approval in conformance with approval procedures.

Remarks space shall be used for necessary comments and the inclusion of information regarding the extension of a manual by minor revisions.

Certification: One of the following certification paragraphs shall be typed in this space, as appropriate:

For manuals being furnished for the first time.

It is hereby certified that NAVSHIPS _____ to be provided under contract number _____ has been approved by the approval data shown above.

For identical manuals.

It is hereby certified that the manuals to be provided under contract number _____ are exactly identical to NAVSHIPS _____ approved by authority of approval data shown above.

For manuals which have been previously distributed but required minor modification.

It is hereby certified that the manuals to be provided under contract number _____ are exactly identical to NAVSHIPS _____ approved by the approval data shown above except for the necessary modification as shown in the above remarks space.

Approval Authority shall include the applicable letters or correspondence granting approval in conformance with approval procedures.

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For manuals being furnished for the first time.

It is hereby certified that NAVSHIPS _____ to be provided under contract number _____ has been approved by the approval data shown above.

For identical manuals.

It is hereby certified that the manuals to be provided under contract number _____ are exactly identical to NAVSHIPS _____ approved by authority of approval data shown above.

For manuals which have been previously distributed but required minor modification.

It is hereby certified that the manuals to be provided under contract number _____ are exactly identical to NAVSHIPS _____ approved by the approval data shown above except for the necessary modification as shown in the above remarks space.

Figure 1. Approval and Procurement Record Page.

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VALIDATION PERFORMANCE				
Title of Publication			NAVSHIPS Number or NAVELEX Number	
Contractor:			Sub-Contractor (if performing validation):	
Contract No(s) and Purchase Orders, if applicable				
Chapter	Section	Paragraph	Date Validation Completed	Check here if not validated
Name & Authority of Validating Officer:			Signature of Validating Officer;	

Figure 2. Content Assurance Page.

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USER ACTIVITY TECHNICAL MANUAL COMMENT SHEET NAVSHIPS 5600/2 (REV. 9/67) (Formerly NAVSHIPS 4914) (COC I - 11-DIGIT STOCK NUMBER: 0105-503-9850)		NAVSHIPS NO _____ VOLUME NO _____
<u>(Fold on dotted line on reverse side, staple, and mail to NAVSEC) Port Hueneme Division</u>		
PROBLEM AREA:		

Note: Both sides of this form to be reproduced locally to size of manual page, as required.

Figure 3. User Activity Comment Sheet, Comment Side.

Fold	
DEPARTMENT OF THE NAVY NAVAL SHIP ENGINEERING CENTER PORT HUENEME, CALIF. 93041 OFFICIAL BUSINESS	POSTAGE AND FEES PAID DEPARTMENT OF THE NAVY
OFFICER IN CHARGE NAVAL SHIP ENGINEERING CENTER PORT HUENEME DIVISION SEC 6865 PORT HUENEME, CALIFORNIA 93041	
Fold	

Figure 4. User Activity Comment Sheet, Address Side.

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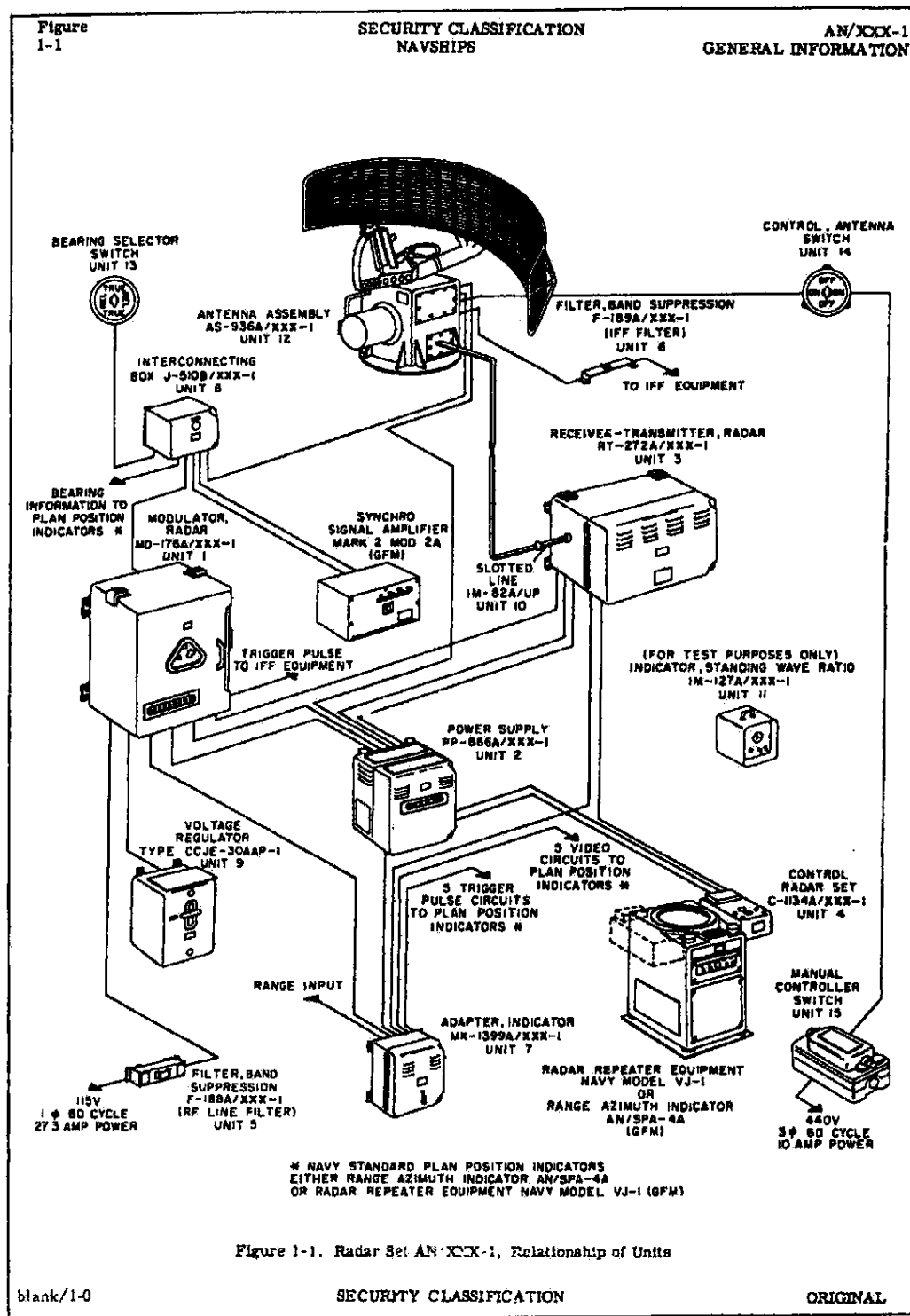


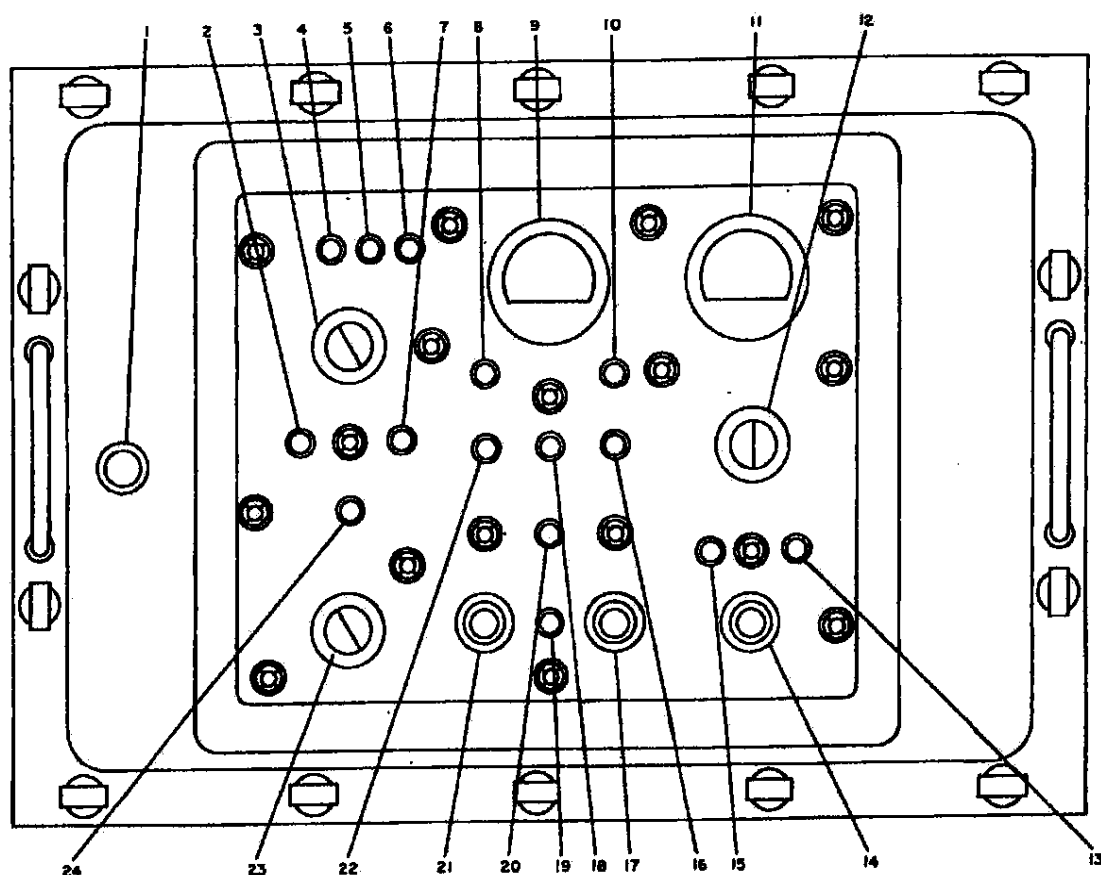
Figure 5. Equipment Illustration Showing Relationship of All Units.

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1. PHONE BUZZ buzzer
2. POWER INTERLOCKS lamp
3. POWER switch
4. STDBY lamp
5. READY lamp
6. TEST lamp
7. CW ILLUMINATOR INTERLOCKS lamp
8. RF POWER DRIVE lamp
9. RF POWER meter
10. RF POWER RADIATED lamp
11. DEVIATION meter
12. DEVIATION switch

13. FM NOISE ALARM lamp
14. NME RESET button
15. AM NOISE ALARM lamp
16. ILLUMINATOR STATUS NO GO lamp
17. RADIATE OFF button
18. ILLUMINATOR STATUS MARGINAL lamp
19. RADIATE lamp
20. HT MODE lamp
21. RADIATE ON button
22. ILLUMINATOR STATUS FAULT lamp
23. DIRECTOR LOUVERS switch
24. DIRECTOR LOUVERS OPEN lamp

Figure 6. Equipment Controls and Indicators.